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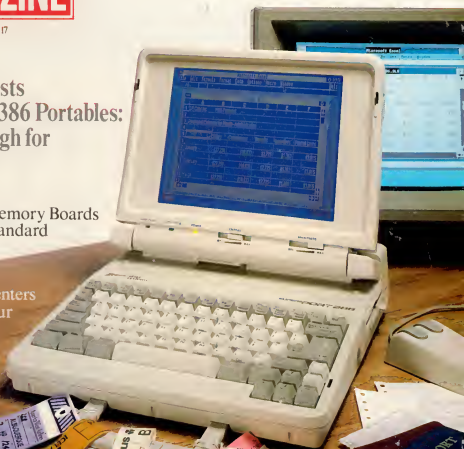
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FROM THIS ROOM**PC  
MAGAZINE**VOLUME 7 NUMBER 17  
OCTOBER 11, 1988**Free Program: Speed Up  
File Access with DCACHE**

# Power Trips

**PC Labs Tests  
12 286 and 386 Portables:  
Good Enough for  
Your Desk?**

■ **9 LIM 4.0 Memory Boards  
Set a New Standard**

■ **13 Defragmenters  
Tune Up Your  
Hard Disk**



# The Revolution continues with our new . . .



# AFTER HOURS



## LANGUAGES

### Putting Your Knowledge of French To the Test

BY P. J. SPRINGER

Some people's sweet tooth can be appeased by a simple sorbet; for others nothing but a chocolate éclair will do. Both tastes are satisfied by Lingo Fun's two offerings in the French language education market—*Le Grand Concours* and *Cloze Encounters* in French.

#### Le Grand Concours

For thorough practice in the fundamentals of French, Lingo Fun makes *Le Grand Concours*. The complete package, which sells for \$110, features a plain and simple user interface that even those with less computer-literacy can easily grasp.

The program is based upon questions taken from the National French Contest, which is held every year for American students of French. The fare is simple: about 200 multiple-choice questions spread out over three floppy disks cover grammar, culture, and reading comprehension at each of the six contest levels.

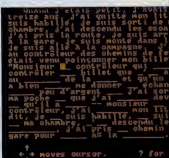
Beginner and intermediate levels 1 through 3 present only the multiple-choice questions and responses in French; all other material (including answer explanations) is in English. Grammar questions at these levels cover everything from the simple past to the present subjunctive verb tenses, relative and possessive pronouns, and other special grammatical constructions. Questions on culture demand a respectable knowledge of the geography, architecture, and history of France, as well as the life-styles of the French people.

Levels 4 and 5 take the challenge well beyond that, covering virtually all aspects of French grammar, culture, and civilization, including arts and literature from the 17th through the 20th centuries. These levels are for only the most fluent—questions, responses, and explanations are all in French.

Explanations of the answers to test questions, though generally very thorough, sometimes lack important information. For instance, the explanation for selecting *mieux* rather than *meilleur*—both of which mean better—fails to note that one is an adverb, the other an adjective.

The program provides positive reinforcement for correct responses. Correct answers elicit a cheery "C'est juste!" or "Très bien!" and scores near or

If you get stuck filling in a missing letter in the Cloze Encounters exercises, the Shift-Exclamation key combination will fill it in for you.



above 90 percent send a congratulatory message moseying across your screen. Unfortunately, a bug in the program causes your machine to occasionally freeze up at this point.

*Le Grand Concours* is a modest program that admirably performs its function of testing the user's proficiency in French.

**List Price:** *Le Grand Concours*, \$39.95 per individual disk, or \$110 for set of three disks. **Requires:** 128K RAM, one disk drive, DOS 2.0 or later. Not copy protected. Lingo Fun Inc., P.O. Box 486, Westerville, OH 43081; (614) 882-8258.

CIRCLE 667 ON READER SERVICE CARD

#### Cloze Encounters in French

Like icing on an éclair, *Cloze Encounters in French* tops off a student's progress in class with a variety of cloze activities. These exercises, which involve the filling in of systematic deletions of letters or words in a given text, demand more diligence from you than does the multiple-choice format of *Le Grand Concours*.

The program is rich in content and should please users with even the most discriminating taste buds. The main menu offers text selections from elementary readings, job portraits,

folk songs, proverbs, and works of Ionesco and Pré-

The program lets you the type of cloze activity to practice, be it fill vowels or consonants, the or last letter of each word, every second, third, fourth or fifth word.

You must indicate a cent, circumflex, and marks using Esc-letter combinations that are far from intuitive. Should you get stuck, a feature lets you a computer to fill in the letter or even to complete text.

*Cloze Encounters* teachers to create, edit, grade their own texts. The game is also available in work version for educational institutions.

The same annoying board freeze-up bug in *Cloze Encounters* exists in *Encounters*. Once the programmers at Lingo Fun fix up their recipes, however, they'll have a couple of French delicacies to satisfy the hungriest linguistic treats.

**List Price:** *Cloze Encounters in French*, \$49.95. **Requires:** RAM, one disk drive, DOS 2.0 or later. Not copy protected. Lingo Fun Inc., P.O. Box 486, Westerville, OH 43081; (614) 882-8258.

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La Suisse est un pays ----- de la France.

- 1) au sud
- 2) à l'est
- 3) au nord
- 4) à l'ouest

Switzerland is located to the east (à l'est) of France, also forming part of France's eastern border area (frontière) with Germany (l'Allemagne) and Italy (l'Italie).

Choices: C(ommentary), N(ext)

At beginner levels, *Le Grand Concours* multiple-choice questions on cultural topics include simple geography. Thorough explanations of the correct answer are available by pressing a key.

is skill and

asy (\$59.99) sections that if the steps ning how to up reaches, vn reaches, special char-, and warm-included.

isplay what e it, and this ; used to. If you are typ-, you aren't /our errors, oncerting at lid keep me ool when I nce you've a selection, key displays gress chart. i game, and at you'll en- if you don't instead of us- ys to move

tice. You choose the length of the drill (up to 5 minutes) and the typing material from any of 104 paragraphs.

You can select any paragraph, the texts of which are taken from *Houghton Mifflin Typewriting: Keyboard Mastery and Applications*. *Skill Builder* maintains a roster of your last 16 scores so that you can follow your progress.

The only problem with *Skill Builder* is that there's not much to it. The \$59.95 purchase price is a bit steep for what it offers; the company would do users a service by incorporating the program into the *Typing Made Easy* package.

*Skill Builder* and *TME* are designed to track, update, and display the progress of multiple students. The programs as shipped can accommodate 20 users, and other options are available. QED offers a site license and networking versions for workstations.

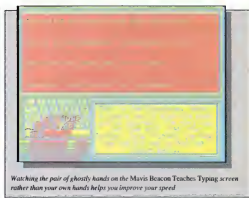


the let- ipe in nrove. The is many of t blocks as i.

ilder is a gram that 'It's de- ping accu- gh prac-

**List Price:** *Typing Made Easy* and *Typing Skill Builder*, \$59.95 each (\$99.95 for set). **Requires:** 128K RAM, one disk drive (both 3½- and 5¼- disks included), DOS 2.0 or later. **Keydisk** copy protected. QED Information Sciences Inc., 170 Linden St., Wellesley, MA 02181; (800) 343-4848.

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## Mavis Beacon Teaches Typing

The \$49.95 *Mavis Beacon Teaches Typing* program, from The Software Toolworks, is the most ambitious of the typing packages reviewed here. Mavis, a fictional character like Betty Crocker and Mrs. Paul, brings artificial intelligence to typing instruction.

As you learn to type, *Mavis* keeps a computer-eye on what you are doing wrong, and, like any good teacher, she customizes your lessons accordingly. For example, I have difficulty with Q's and Z's. *Mavis* spotted my feebleness right away, and she concocted lessons and exercises rich in those letters.

You begin each lesson at the chalkboard, where *Mavis* tells you what you are about to learn... and why. Then it's off to the classroom section of the program to watch a demonstration of the lesson. The computer shows a pair of ghostlike hands moving over a keyboard displayed on your screen. By watching these fingers (instead of your own) when it's your turn to type, you can significantly improve your speed. From the classroom you go to the workshop where you practice, practice, practice what you've learned.

You'll find none of the hum-

drum asdf;lkj-stuff of high school typing class drills here. The texts are taken from famous quotations, *The Guinness Book of World Records*, and other interesting material.

If *Mavis* has a weakness, it's her typing game. You're in a race car, and the faster you type, the faster you go. That's it. Even *Typist*'s simple game is more fun than *Mavis*'s dragger. But when it comes to checking your progress, the old girl really outdoes herself. There are 20 graphs that clearly show you exactly where you stand.

*Typist*, *Typing Made Easy*, and *Typing Skill Builder* are all perfectly acceptable training programs, but *Mavis Beacon Teaches Typing* is smarter than any of them—she customizes lessons to identify and then correct your weaknesses. You might get a better game with *TME*, but *Mavis* is the best teacher and provides the best dollar value around.

**List Price:** *Mavis Beacon Teaches Typing*, \$49.95. **Requires:** 256K RAM, two disk drives (both 3½- and 5¼-inch disks included), DOS 2.0 or later. Copy protected (hard-disk-installable version, \$10 extra). The Software Toolworks Inc., One Toolworks Plaza, 13555 Ventura Blvd., Sherman Oaks, CA 91423; (818) 907-6789.

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# and Turbo C 2.0!

## Turbo C 2.0 has the best of everything

- Includes the compiler, editor, and debugger, all rolled into one
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- Inline assembler support
- Support for Turbo Assembler and Turbo Debugger
- Make facility with automatic dependency checking
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- Only \$149.95

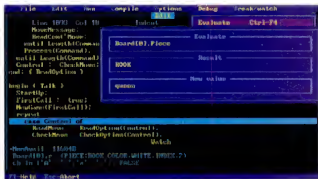
## New Turbo C Professional

Turbo C 2.0 plus both Turbo Assembler & Turbo Debugger: all three programs rolled into one—the one C package that has everything. A complete set of tools that caters to every level of programming expertise. Turbo C Professional: \$250. Includes coupon for free T-shirt (while supplies last).

## New! Turbo Pascal® 5.0 with integrated source-level debugger

Turbo Pascal, the worldwide favorite with over a million copies in use, just got even smarter. The best got better. Meet Version 5.0. In a word, it's revolutionary.

Not only do you go code-racing at more than 34,000 lines a minute,\* you also now go into a sophisticated debugging environment—right at source level.



Shown here is the Evaluate/Modify window of Turbo Pascal: look at expressions, examine structured data types, change variables on the fly.

## It's completely integrated and bullet-fast.

Turbo Pascal's new integrated debugger takes you inside your code for fast fixes. You step, trace, set multiple breakpoints. You modify variables as you debug and watch full expressions at runtime.

## Separate Compilation

Break your code into units. Your separately compiled units can be shared by multiple programs and linked in a flash with Turbo Pascal's built-in Make utility and smart linker. We give you a powerful library of standard units including the spectacular Borland Graphic Interface and our state-of-the-art overlay manager.

## Feature highlights

- Includes the compiler, editor, and debugger, all rolled into one
- Integrated source-level debugger lets you step code, watch variables, and set breakpoints
- Overlays, including EMS support
- 8087 floating-point emulation
- Support for Turbo Assembler and Turbo Debugger
- Procedural types, variables, and parameters
- Smaller, tighter programs: Smart Linker strips both unused code and data
- Constant expressions
- EMS support for editor
- Only \$149.95

## Debugging: The inside story

Turbo Pascal's new integrated source-level debugger takes you inside your code to fix errors fast. Don't worry about errors, everyone makes them; but with the right debugger, this one, it's a fast fix.

## Turbo Pascal Professional®

Turbo Pascal 5.0 plus both Turbo Assembler & Turbo Debugger: all three programs rolled into one—the one Pascal package that has everything. A complete set of tools that caters to every level of programming expertise. Turbo Pascal Professional: \$250. Includes coupon for free T-shirt (while supplies last).

TURBO PASCAL 5.0	TURBO PASCAL 5.0	Turbo Pascal 4.0
SIEVE BENCHMARK	1440	1504
EXE size (bytes)	6.15	7.25
Execution time (seconds)		
FEATURE COMPARISON		
Integrated debugger	Yes	No
Overlays, including EMS support	Yes	No
8087 floating-point emulation	Yes	No
Turbo Debugger support	Yes	No
Procedural types, variables, parameters	Yes	No
Smart linking of code and data	Yes	No
Constant expressions	Yes	No
EMS support for editor	Yes	No
Benchmark (25 iterations) run on an IBM PS/2 Model 60		

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March 15, 1988



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Microprocessor	80386 32-bit 20MHz 32KB, 82385 Memory Cache (35ns)	80386SX 16-bit 16MHz	80286 16-bit 10MHz 0 wait-state	80386 32-bit 25MHz 64KB Extended Emulation 82385 Memory Cache (25ns)	80386 32-bit 25MHz 64KB Memory Cache (30ns)
PC Lab Benchmarks Score, Instruction Mix - Seconds	<b>2.75 SEC.</b>	<b>4.56 SEC.</b>	<b>7.20 SEC.</b>	<b>2.20* SEC.</b>	<b>2.36* SEC.</b>
Optional Math CoProcessor	80387 20MHz	80387SX 16MHz	80287 10MHz	80387 25MHz	80387 25MHz
Memory (RAM)	1MB (80ns)	1MB (100ns)	1MB (85ns)	2MB (60ns)	2MB (80ns)
Storage	1 2MB, 5 1/4" FD 1 4MB, 3 1/2" FD	1 Optional (\$225.00)	Not Available 1	1 Optional (\$225.00)	Not Available 1
Fixed Disk and Opt. Internal Full Height Fixed Disk	40MB (28ms) 66MB or 100MB	40MB (28ms) No Support	60MB (27ms) No Support	150MB (18ms) 150MB or 300MB	120MB (23ms) No Support
Video	Optional 16 bit VGA (\$399.00)	16 bit VGA	VGA	16 bit VGA	VGA
Price	\$4499.00	\$5199.00*	\$4595.00*	\$4499.00	\$11,295.00*

\* Prices and configurations as of August 1988 and subject to change



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VOLUME 7 NUMBER 17

# WHAT'S INSIDE

It would hardly be an exaggeration to say that products live and die by the PC Labs Benchmark Test Series—and so does the reputation of *PC Magazine*. That's why, when we find what seem to be aberrant or surprising test results, we take a long, hard look at our testing methodology and thoroughly examine the claims a vendor has made before we come to any conclusions about a product's performance. Sometimes that means changing our code or even the assumptions we've made about what we should be testing. More often than not, as in the case of contributing editor Winn L. Rosch's story "Leveraging RAM with LIM 4.0," PC Labs becomes something of an adjunct quality-control department to the computer industry. When complications arise, the Labs troubleshooters find themselves working with vendors to get to the bottom of and fix problems that might otherwise have gone unnoticed.

**PRESSING ON** For seven of the nine LIM 4.0 boards PC Labs evaluated, our tests showed that absolute conformance to the Lotus/Intel/Microsoft expanded memory specification was at issue. "We had expected that most of the wrinkles would have been worked out by now and that the boards would have passed our tests, since the spec was announced more than a year ago," said Stuart R. Greenberg, a senior programmer at PC Labs. With Pamela Milland, a PC Labs project leader, Greenberg had the formidable task of figuring out why all but Intel's boards could not ad-



Senior programmer Stuart R. Greenberg and project leader Pamela Milland: solving the LIM 4.0 compatibility riddle.

dress certain LIM 4.0 functions.

Working closely with each vendor's technical support staff, Greenberg and Milland determined that the errors were caused by incompatibilities in the boards' Expanded Memory Manager, a device driver that controls expanded memory and applications that use expanded memory. According to Greenberg, it was only because the PC Labs LIM 4.0 performance tests were designed to use the specification rather than simulate real-world applications that these discrepancies became apparent.

Many phone conversations and some long long-distance debugging sessions took place before each vendor supplied PC Labs with new Expanded Memory Managers. To our delight—and relief—they all passed our tests, confirming what we already knew: this was just one more instance of a PC Labs performance test serving double-duty as a diagnostic tool, as well as one more time when a collaborative effort between *PC Magazine* and the computer industry helped improve a whole class of products.

PC Magazine: The Independent Guide to IBM Standard Personal Computers (ISSN 0898-8917) is published bi-monthly in July and August for \$19.95 for one year (12 issues), \$41.95 for two years, and \$81.95 for three years. Additional postage \$5.00 per copy or \$22.00 per year for Canada and all other foreign countries. J.B. Stone Publishing Co., a division of J.B. Communications Co., One Park Ave., New York, NY 10018. Second-class postage paid at New York, NY 10018 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 50070, Boulder, CO 80521-0707.



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\*JetScript available for IBM PC-XT, IBM PC-AT, HP Vectra™ and compatible personal computers, or the IBM PS/2™ Model 30.

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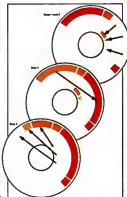
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 Roberto Brosan

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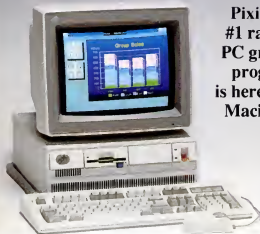
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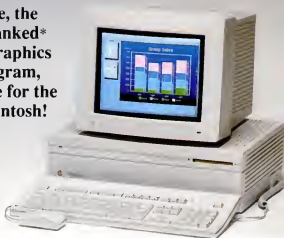
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and laser printers**


**Shares files, art, and presentations  
with that other computer** 

**Creates beautiful graphs and drawings  
quickly and easily on the Macintosh**

**Fully utilizes standard Macintosh  
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# Any cell can contain a command that you can access



Fig. 1 Let's get the detail on those ad costs. Just move the widerbar to that cell and press one key (Grey +).



Fig. 2 Here we are, instantly. Notice the lower left corner showing we are on level 2. You can go down or up.

## What Makes Lucid 3-D So Special

In the screen examples you can see Lucid is really three dimensional. Any cell of the spreadsheet can contain a complete other spreadsheet that you can access with a single keystroke. It is as simple as the pictures show. And you don't have to write formulas to do that.

All you do is go look at the other file, navigating through easy, point and shoot directories. When you come back up (with one key) the link is made automatically for you.

Everything about Lucid works that way. Users say "It is so intuitive that I really don't need a manual." That's because we use something we call a visual command menu. Jim Seymour, the noted PC columnist, talking about Lucid in a recent article said that: "If there ever was an interface idea so good it ought to be stolen and widely used, this is it."

What he was talking about is a new menu approach that follows a simple design concept: it is easier to recognize than it is to remember. As choices are made on a menu that take you to lower levels you always can see exactly where you came from and where you are going. The complete menu path is always visible. You cannot get lost several levels down. This means you never have to remember a command, you just flow right to it.

Plus, no matter where you are on a menu or what you are doing, just press function key F1, and you will get a help screen specific to that command or action. Or if you want to know about any subject you can pop up an index of over 600 topics and select the one you want.

## Notepad Behind Every Cell

Another 3-D feature is that any cell can also contain a multiple page note that you instantly access with a single keystroke. You can write notes, memos or letters that relate to your work, save them as individual files and even print them separately or with your spreadsheet.

"I've been calling it an 'Everyman's Spreadsheet', and I think that's how the market will position it. It's much more than an inexpensive alternative to 1-2-3."

Jim Seymour, Columnist, PC Magazine, PC Week

## Speed

Lucid 3-D™ is truly revolutionary. It is fast, fast, fast! It is incredibly quick in performing calculations because it doesn't recalculate every cell every time you insert an entry. Instead, it only recalculates the specific cells that are affected by your change. This is called minimal recalc. Lucid also has a remarkable innovation called background recalc in which you are given control of the cursor the moment calculations affecting your viewing screen are completed. Other calculations



Fig. 3 We want more detail, so let's go to Newspapers. Just press the Grey+ key.



Fig. 4 Now, instantly we are on level 3. Each level is a different spreadsheet. You could now move to the New York Times and see the detail on that figure. There is no limit to the levels you can go. Move right down to transaction level if you like.

you don't see continue on in the background during the next commands. The end result of this powerful combination is you rarely wait for a recalculation with Lucid. You find out what instantaneous is all about.

## Lucid Learns

Lucid 3-D™ also lets you teach it in any combinations of keystrokes so that involved sequences can be done with single keys. Plus more than just remembering keystrokes, Lucid allows you to create Macros with loops, procedures and conditional branching amazingly all done automatically with simple menus. You can create your own menus that show the new features you have taught it. Another great feature is you can make your custom menus work like Lucid where one choice can take you

# Complete other spreadsheet with a single key.



Fig. 5 Of course, Lucid does multiple windows. Notice, you can simultaneously open windows in different directories, different drives, even down as many 3-D levels as you like. No one else can do that.

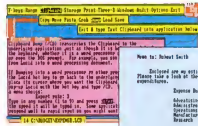


Fig. 6 We need those budget figures in the Word Perfect letter we are writing. Clipboard Dump does it right now.

Fig. 7 (Below) Here it is right in Word Perfect (or any word processor) just like you typed it. You can go the other way just as easily.



down a level to a whole new set of choices. What's nice is that they will work from one spreadsheet to another.

## Mouseability

Lucid 3-D™ was designed for both keyboard enthusiasts and mouse lovers alike. You can take your pick. Designed around the mouse from the ground up, the interface is smooth and natural. You select files to load from directory lists. Everything is point and click. What's more, any Lucid 3-D™ menu selection can be "moused" and the response time is "right now" instead of the sluggish "a little bit behind you" feel of add-on mouse menu systems like those you've seen with 1-2-3.

A window pops up with a library of function names you can page through with the mouse. Select, click and it's in the formula with no typing required. You even have a label window that you can fill (from the keyboard) with favorite labels and names so that you can insert them later with the mouse. There's even a pop-up calculator to insert numbers so you don't have to go to the keyboard very often.

It really permits that feeling of becoming one with your work. Lucid 3-D™ has windows of user defined range names as well as the macros named by the user that can be selected just by pointing and clicking. Icons that are

easy to grab with the mouse let you resize and move the spreadsheet window with the ease you would expect. Plus you can go anywhere on the sheet by moving the mouse and clicking on the spreadsheet borders. And remember, Lucid is designed so that any of those features are done with or without the mouse easily and quickly.

## Audit

When you are staking a big decision on information gained from a spreadsheet you need to be certain that you have made no mistakes. Lucid 3-D™ offers five audit displays and printouts.

Even if you don't plan to abandon 1-2-3, Lucid makes sense. Files are

converted between them with ease so there's not an interface compatibility problem. This means you can have the power and fun of Lucid 3-D™ without having to upset your present systems.

We are excited about Lucid 3-D™. But don't take our word for it, take us up on our 60 day offer.

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Everyone's computing needs are unique. Which is why different people choose different solutions. And why so many diverse computing environments are being used today.

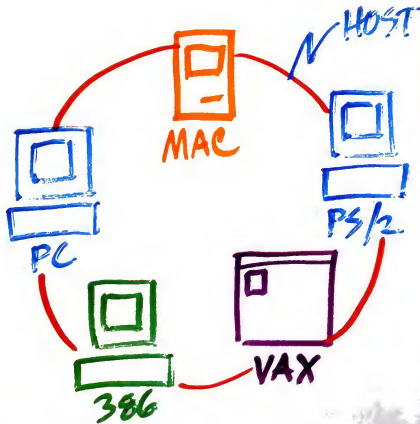
While this variety of solutions makes it easy for users to meet their needs, it presents some problems. Like sharing information between incompatible systems. The kinds of problems facing more and more companies as their information systems grow and diversify.

**Novell means freedom.** Fortunately,

you can solve those problems by making one simple choice: Novell. Novell's NetWare® operating system software supports a myriad of computing environments.

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## and you can choose all of these.

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And as your computing needs expand, the network will grow with you. Giving greater networking capability and allowing you to connect to new environments.

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Introducing the Ven-Tel Pathfinder™ 18K. It's the fastest dial-up modem available, and it works better over poor phone lines than any other modem. Plus, it guarantees that your data will be 100% error free.



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Though other high-speed modems may *claim* speeds up to 19,000 bps, they rely exclusively on data compression, and can only achieve these speeds on excellent quality phone lines.

But the Pathfinder 18K has a unique ability to adapt to the changing quality of the typical phone line: it falls back in small 100 bps increments and can bounce back again when line conditions improve! So in the real world, it actually transmits nearly twice as fast as other modems—up to 18,000 bps *without* data compression. Keep that in mind when comparing modems.

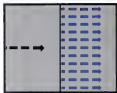


"Picture-perfect transmission for CAD/CAM and graphics."

What's more, if lines do deteriorate badly, the Pathfinder 18K's own data compression automatically kicks in to keep you moving at the highest possible speed.

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# LETTERS TO PC MAGAZINE



## LOOKING AT LAN SOFTWARE

Frank J. Derfler, Jr.'s article ("Software: Connectivity's New Frontier," *PC Magazine*, June 14, 1988) was remarkable for its



volume, quality, and sensitivity to the complexity of local area networking. No one contemplating the installation of a LAN should proceed without reading this article.

Howard Jacobson  
Washington, D.C.

I would like to commend *PC Magazine* on your comprehensive connectivity article ("A Field Guide to LAN Operating Systems," *PC Magazine*, June 14, 1988). Unfortunately, the issue's LAN comparisons and the features table provided no information about TCP/IP support or adherence to the multilayered OSI standard.

For the most part, however, the story was accurate and informative, and I thank you for your excellent reporting.

Jorge A. Pascual  
Miami, Florida

## BIG, BAD BUSINESS

John C. Dvorak discussed the greed of American semiconductor firms and American petroleum firms in Texas ("Repent! The End Is Near," *PC Magazine*, June 14, 1988). His statements seem to indicate that

he does not understand economic feasibility and that one must make money to remain in business.

Kenneth D. Conner  
Richardson, Texas

*I may not understand all aspects of economic feasibility, but I do understand the concept of greed in the semiconductor business.*—John C. Dvorak

## WILL THE REAL PC USERS PLEASE STAND UP?

All the gushing over OS/2 is amazing. It shows how far out of touch the gurus in Redmond and the magazine editors in New York are with real PC users.

Real PC users are not big corporations or government; we are the millions of small businesses and professionals across the country. When we buy computers and software, we are spending our own money. Cost matters, and we are not going to throw our XT and AT clones in the dumpster for the privilege of buying new \$5,000 computers and \$750 software.

Patrick B. Anderson  
Issaquah, Washington

## DIFFERENT STROKES

While I was pleased to see the review of our numerical analysis software, *SolveIT* (First Looks, page 46, *PC Magazine*, July 1988), I feel that I must respond to Barry Simon's statement that "*SolveIT* seems to be unique in making virtually no use of the alphabet keys."

A reduction of keyboard input is exactly what we were trying to accomplish. What we offer is a context-sensitive graphical interface that uses a mouse for input.

*SolveIT*'s interface is easier to use than free-format entry systems, has less for us-

ers to memorize, and can be used to build large problem-solving programs. Mr. Simon clearly prefers to use keyboard entry, but that doesn't mean that any other entry method is "flawed."

Tom Ochs  
President  
Structured Scientific Software  
Albany, Oregon

*I recognize that the P in PC stands for "personal," and that there will be a broad spectrum of responses to any given interface. However, I find it hard to believe that anyone would prefer an interface in which he needs to write a little program that begins by storing x, requires several recalls of this stored value, and forces him to worry about what is in which register. I stand by my assertion that a promising program is hampered by a poor interface.*

—Barry Simon

## IN THE INTEREST OF SCIENCE

Your review of scientific word processors was very informative ("Scientific Word Processors: Formulas for Success," *PC Magazine*, July 1988). Don't rest on your laurels though. Do scientists and engineers a huge favor and review statistical applications that run under DOS. And, if you want to do a really effective job, get input from some statisticians.

I believe you will find it a fascinating topic that will greatly benefit your readers.

Kevin A. Hodge  
Georgia Institute of Technology  
Atlanta, Georgia



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## LETTERS

PC Magazine is planning a statistical applications article to be published this winter.—Ed.

### QUALITY SUPPORT

Your magazine is an invaluable resource to me, but there is one aspect of product value that I feel has been underaddressed in your reviews. Second-rate telephone support seems to prevail in the computer industry; software companies need to be held accountable for the service they render.

PC Magazine has become a watchdog over the quality of software packages. You would do all computer users a great service by becoming our advocate in this area as well.

Greg Dunn  
Woodland Hills, California

### ...OR YOUR MONEY BACK?

In your recent review of the VEGA VGA board ("Nearing Perfection: VGA Boards Enter the Mainstream," PC Magazine, July 1988), Winn L. Rosch stated that the VEGA was not completely compatible with IBM's VGA standard, but went on to explain: "If you have doubts, its money-back compatibility guarantee should reassure you."

The article should have also stated that this guarantee is applicable only to IBM PCs, not compatibles. I purchased a VEGA VGA board, and it will not work in either my Mitsubishi MP386 or my Compaq Portable III. Video Seven has refused to refund my money, because the guarantee specifies only IBM PCs, not compatibles.

Arthur V. English  
Gwynedd, Pennsylvania

### A COLLISION COURSE

I think there are some misconceptions about the performance of workstations (Bill Machrone, "When Worlds Collide," PC Magazine, June 14, 1988). Workstations do deliver number-crunching performance and good network support, but they lack responsiveness. This poor performance is caused by inadequate

hardware support and inefficient implementation.

Memory is also a problem. Workstations require a great deal of paging. The speed of PC hard disks and controllers must improve to sustain this load. In the meanwhile, I prefer real memory to "Virtual Mumpitz" (Mumpitz: German for nonsense).

Pascal Dornier  
Zollikon, Switzerland

### A FRESH UTILITY

I am astounded by the improvement in overall performance of my IBM PC-XT compatible that was obtained through use of the refresh utility, QFRESH.COM, by Brian K. Roemmele (PC Lab Notes, PC Magazine, July 1988). This utility is worth many times the cost of my subscription to your outstanding magazine, and I wish to thank you for publishing it.

Addison H. Lynch  
Fort Worth, Texas

Brian K. Roemmele's article (PC Lab Notes) contained two or three of the most useful tips I've gotten from years of reading various PC Magazine articles. This is quality work!

Terry Rich  
Dickinson, North Dakota

### PRIZE-WINNING PROGRAMMERS

I would like to second John C. Dvorak's motion to honor outstanding programmers ("The Software Entropy Effect," PC Magazine, June 28, 1988). Displaying the author's name would give credit where it is due. Perhaps outstanding writers who continually produce top-notch works and bring repeat sales to companies should be eligible for the Nobel Economic Prize.

Brian L. Jones  
Glenview, Illinois

### BELLY UP ON BAR CODES?

In his bar-code-readers review, Greg Alwang stated that the MiniBar "didn't achieve the same level of successful reads" of other tested units ("Reading Between the Lines," PC Magazine, June 28, 1988).

The explanation for this may be that we supplied a high-density pen with the MiniBar that appears to have been used on

	1986	1987	1988
Asset Exchanges (Note E)		\$28,500	\$17,500
Supplies	\$104,576	\$17,549	\$87,145
Installations (Note F)	\$4,500	\$17,500	
Additional to fixed assets	\$109,076	\$177,649	\$104,645

Statement of Income		1988
Income from operations	\$1,193,375	
Interest and dividends	\$76,433	
Income before income taxes	\$1,270,408	
Provision for income taxes	\$472,604	
Net income		
Dividends per share		

At Cost Depreciation		1988
Summary Schedule:		
Land	\$250,000	
Buildings	\$6,700,000	
Furniture	\$72,000	
Machinery		
Other equipment		
Transportation		
Leasehold improvements		

	1986	1987	1988
<b>Sources of working capital:</b>			
Net income	\$254,771	\$682,094	
Non-cash charges to income:			
Deferred income taxes	\$15,000	\$137,560	
Depreciation and amortization	\$15,432	\$25,267	
Working capital from operations	\$285,203	\$844,921	\$980,664
Sale of fixed assets	\$64,676	\$94,889	\$37,695
Issuance of common stock	\$17,884	\$43,786	\$34,866
Issuance of preferred stock	\$17,000		
Total sources	\$384,763	\$983,696	\$1,053,225
<b>Uses of working capital:</b>			
Additional to fixed assets	\$109,076	\$177,649	\$104,645
Dividends paid on capital stock	\$38,764	\$89,523	\$117,490
Total uses	\$254,674	\$378,931	\$348,572
Increase in working capital	\$129,289	\$604,765	\$704,653

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Non-cash charges to income:				
Deferred income taxes	\$15,000	\$137,560		
Depreciation and amortization	\$15,432	\$25,267		
Working capital from operations	\$285,203	\$844,921	\$980,664	
Sale of fixed assets	\$64,676	\$94,889	\$37,695	
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Consolidated Sales		1986	1987	1988
Product Line				
Application	\$45,120,000	\$51,120,000	\$53,120,000	
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Services	\$12,120,000	\$13,120,000	\$14,120,000	
Lease & Rental	\$13,120,000	\$14,120,000	\$15,120,000	
Transportation	\$14,120,000	\$15,120,000	\$16,120,000	
Other	\$15,120,000	\$16,120,000	\$17,120,000	
Total	\$111,600,000	\$123,600,000	\$130,600,000	

regional sales worksheets to produce a national consolidation.

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## ■ LETTERS

low-density-code samples. Furthermore, no effort was made to normalize the code samples, the differing reading techniques of reviewers, or the percentage of good reads that justified your evaluation.

Jeremy Metz  
President  
Barcode Industries Inc.  
Beltsville, Maryland

## A CASE OF THE VAPORS

Why are we in the MS-DOS world meekly sitting on our hands hoping that one day the sky will part and we will be handed a worthwhile operating system? OS/2 is still virtually vaporware: we're kidding ourselves dreaming about 80486 chips when we can't even use the 80286 fully.

Unless we stop supporting this dead-end technology, we'll all be left with 8086 machines playing Pac Man.

Hans Goldfuss  
New York, New York

## LOOK MOM, NO HINT BOOK!

In her *Space Quest II* review (After Hours, *PC Magazine*, June 28, 1988), Stephanie K. Losee wrote that solving *Space Quest II* required the hint book. Well, I managed to solve all the Sierra Adventure games without having to use the hint book, and I am only 13 years old.

Richard G. Biase  
Montville, New Jersey

## SKEWED DEFINITIONS

I believe that a very valuable and inexpensive package was subjected to inaccurate evaluation with a cheap shot ("Software Safety Nets," *PC Magazine*, May 31, 1988). In David DeJean's review, *PC Tools Deluxe* was referred to as deserving the "Ginsu Knife Memorial Trophy." In my opinion, it should have been labeled the "Professional-Strength Swiss Army Knife."

Roy F. Schall  
Glendora, California

## THE BUCK STOPS HERE

I recently learned that Morris Stemp, who cowrote the review of *Macola Accounting Software* ("Making Every Number Count," *PC Magazine*, September 15, 1987), the Editor's Choice accounting package, has a vested interest in Macola

Inc. He is a distributor for Macola and sells and installs the program.

This discovery deflates my faith in the reliability of your editorial evaluations, which I had believed to be fair and impartial product reviews. That you may obtain your articles in this barter manner seems to contradict Jim Seymour's firm assertion of complete editorial independence in his "the buck stops here" statement ("Ethics and Articles of Faith," sidebar to "Automating Your Books, Analyzing Your Options," *PC Magazine*, September 15, 1987).

Ken Rubin  
New York, New York

*PC Magazine deliberately sought reviewers on the accounting project who had previous experience with the software. Mr. Stemp has installed products from Macola, TLB, Computer Associates, and others. As Jim Seymour explained in "Ethics and Articles of Faith," anyone who's knowledgeable about accounting software has some prejudices, and PC Magazine accepted the responsibility of being an impartial arbiter for the Editor's Choice selection.—Ed.*

## NOTHING BUT THE TRUTH

David DeJean's review of the Micro 1 Power 386 ("20-MHz 386s: Hustle with Muscle," *PC Magazine*, June 28, 1988) stated that the Mylex motherboard is socketed for both the 80287 and 80387 math coprocessors. A call placed to Mylex by our executive vice president was answered with an emphatic denial of such a product's existence.

What is the real truth?

Lisa M. Hartsock  
Assistant Sales Manager  
FiveStar Computers  
Carrollton, Texas

*The truth is somewhere in the middle. An 80287 can be plugged in, but an 80387 requires a daughtercard from Mylex.—Ed.*

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## ■ JOE DESPOSITO

## PC ADVISOR



*Advice on a variety of ways to market shareware, adding an external 3 1/2-inch floppy disk drive to the AT&T 6300, and turbocharging an 8086-based machine.*

**HOW TO SHARE**

I am developing some small programs that I would like to try and market as shareware. How does one go about getting his programs into the shareware marketplace? Is there a publication or other information source available on this?

Joe LaBelle  
Flagstaff, Arizona

*I don't know of any publication devoted to marketing shareware, but I can give you a few pointers on how to do it. The best way to start marketing your shareware programs is by uploading them to on-line services such as CompuServe (5000 Arlington Center Blvd., Columbus, OH 43220; (800) 848-8199), The Source (1616 Anderson Rd., McLean, VA 22102; (800) 336-3366), Delphi (General Videotex Corp., 3 Blackstone St., Cambridge, MA 02139; (800) 544-4005), and GENie (General Electric Information Services Co., 401 N. Washington St., Rockville, MD 20850; (800) 638-9636, ext. 21). Look for areas of the service that bring together users who are interested in PCs. On CompuServe, for instance, upload your programs to PC Magazine's PC MagNet (for more information, see *First Looks*, page 46, PC Magazine, May 31, 1988) and the IBMNet Forum.*

*The next places to target for uploading your programs are bulletin boards. One of the best is Bob Mahoney's Exec PC, out of Shorewood, Wisconsin; ((414) 964-2227). For a more complete directory of bulletin boards throughout the country, pick up a copy of Computer Shopper (Coastal Com-*

*munications, 5211 S. Washington Ave., Titusville, FL 32780; (407) 269-3211). There is also a bulletin board about bulletin boards at (301) 251-9206. Keep in mind, though, that your programs may find their way to these bulletin boards naturally—by satisfied users placing them there.*

*Another avenue for marketing shareware is through user groups. Computer Shopper also lists user groups throughout the country. Two large organizations of this type are the NYPC user group (80 Wall St., #614, New York, NY 10005; (212) 533-6972) and the Capital PC user group (51 Monroe St., Plaza East 2, Rockville, MD 20850; (301) 762-6775).*

*Finally, you could contact shareware vendors such as PC-SIG (1030D E. Duane Ave., Sunnyvale, CA 94086; (800) 245-6717). These companies market on-disk shareware which can be purchased through mail-order or computer outlets.*

■ Shareware is a great concept—a user can try software and then, if satisfied, pay a relatively small registration fee directly to the author.

*PC-SIG also publishes a bimonthly magazine called Shareware as well as the "HOT Sheet" and a directory of shareware titles.*

*You should also be aware of ASP—the Association of Shareware Professionals (4317 Commonwealth Ave., Charlotte, NC 28205). Members of the organization can be contacted on CompuServe through IBMSW, PC MagNet Editorial, or Util-Forum (be sure to include the word "shareware" in the subject title of any message you send).*

*Shareware is a great concept—a user is allowed to try out a particular software product and then, if satisfied, pays a relatively small fee (a registration fee) directly to the author. Although there are some people who treat shareware as "free" or public-domain software, there are many others who show their approval of a product by sending in the fee. I like the shareware idea because it appeals to such higher human qualities as trust, respect, responsibility, and an individual's general sense of fair play. And although the concept is abused by some users (and authors, too), it works well enough to be a viable concept.*

**AT&T 6300 FLOPPIES**

*I have an AT&T 6300 with one floppy disk drive and a hard disk. I want to add a 3 1/2-inch external floppy disk drive as my B: drive. Can you help me?*

A. Weaver  
Bronx, New York

*Connecting a 3 1/2-inch floppy disk drive to an AT&T 6300 can be a problem for two*



## ■ PC ADVISOR

reasons: first is the absence of an external DB-37 connector (like the one on the IBM PC floppy disk controller), and second is the awkward positioning of the floppy disk controller, which resides underneath the system board. One company that has addressed this problem is Manzana Microsystems Inc. (7334 Hollister Ave., Suite B, Goleta, CA 93118; (805) 968-1387).

In the absence of a DB-37 connector, Manzana's solution is the MUX (multiplexer) card. It provides the DB-37 function when you plug it into an expansion slot on the 6300 system board. It then connects with the floppy disk controller and disk drive (the included cable is long enough to reach the controller). The MUX card also has a way to supply power to the external drive. The 720K host-powered 3½-inch Manzana MDQX external floppy disk drive has a suggested retail price of \$395 and includes the MUX card, cables, and device driver.

## SPEED BOOST FOR AN 8086

I have owned an AT&T 6300 monochrome system for a number of years now, and although I am pleased with its reliability and overall compatibility—at least at a software level—its performance vis-à-vis the current crop of machines leaves a lot to be desired. Do you know of any 286 or 386 accelerator cards that are compatible with the AT&T 6300?

Wayne J. Wallace  
New Canaan, Connecticut

The AT&T 6300 is not compatible with most 80286 and 80386 accelerator boards. One of the reasons is its 8086 microprocessor (the IBM PC has an 8088 microprocessor). However, Applied Reasoning (86 Sherman St., Cambridge, MA 02140; (617) 492-0700) makes a board called the PC-Elevator that works with the AT&T 6300 (all system-board versions). PC-Elevator is a coprocessor board that

puts a second independent computer inside its host and requires no more in the way of installation than simple insertion. PC-Elevator 386, reviewed in the April 12, 1988, issue of PC Magazine, lists for \$1,795. For those of you with an extensive collection of PC Magazines, a review of the PC-Elevator 286 appeared in the September 16, 1986, issue. The product received a mixed review at the time, so it would be wise to inquire whether or not its deficiencies have been corrected. The PC-Elevator 286 lists for \$995.

PC-Elevator boards work not only with the AT&T 6300, but with PCs,XTs,ATs, and most clones, no matter what the native processor.

## ASK THE ADVISOR

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# FIRST LOOKS

## Framework III Strengthens Modules, Adds Network Support and E-mail

### PC HANDS ON

BY CRAIG STINSON

*Framework III*, the latest incarnation of Ashton-Tate's venerable integrated package, is full of welcome improvements. For those whose daily bread is earned by juggling disparate bits of numerical, text, and graphic information, *Framework III* is a highly appealing, if

still imperfect, tool.

Its appeal comes chiefly from its superb ability to structure information (the heart of *Framework* is an outline); its most frustrating imperfection lies in the area of presentation-quality output.

The biggest difference between *Framework II* and *Framework III* is the new LAN support and e-mail. The LAN version (which is scheduled for

shipment in September) will offer file sharing in three modes: read/write, read only, and exclusive.

The mail service, by way of Action Technologies' Message Handling Service (MHS), augments the program's built-in communications capability by allowing *Framework* users to exchange messages transparently with MHS-equipped associates. MHS is a standard com-

ponent of the *Framework III* LAN product; for standalone users, it's a \$100 add-in.

Enhancements also include new or revised features in each of *Framework's* modules.

The word processor now includes an excellent thesaurus, greatly expanded search-and-replace capability, and columnar text that snakes on the screen as you edit. *Framework*

(continues on page 34)

## PackRat Shortens PIM Learning Curve with Predefined Structure

### PC HANDS ON

BY NEIL J. RUBENKING

Personal Information Manager—the notion sounds grand until you realize that you personally have to tell the software how to manage your information. If you don't have a spare week to study the program intensively, you may wind up hiring a consultant to organize it for you. Or you might just choose Polaris Software's *PackRat*, a PIM that's ready-made to manage executive information.

*PackRat* stores information in the form of lists and attachments. All data goes into one of seven lists, indexed by keywords. Attachments relate items from different lists—for example, a logged phone call to the caller.

The package requires Micro-

soft Windows, Version 2.03, or later and fully exploits the Windows graphical user interface. One or two mouse clicks will reach most operations. No mouse? Keyboard commands

and shortcut keys make *PackRat* usable anyway.

*PackRat* is meant to work in real time—to record phone calls as they happen, warn you of

(continues on page 35)



*PackRat centers around seven pre-defined lists. You click on a list in the list stack, upper right, to zoom it into the detailed display.*

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## Framework III

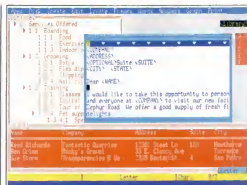
(continued from page 33)

III is one of few programs, integrated or otherwise, that let you see the side-by-side layout of snaking text as you write and edit. You can even wind the text around graphs, spreadsheets, and databases.

You'll also find a few other welcome additions, such as individually adjustable tab stops; superscript, subscript, and strikeover character attributes; rudimentary footnoting; and hyphenation.

The spreadsheet now includes selective recalculation, but, alas, no minimal recalc technology. You can avoid lengthy recalc delays by using the F6 key to select the area of a worksheet you need recalculated, then pressing Shift-F5 to update just that selection.

Other improvements to the spreadsheet include import/export service for *Lotus 1-2-3*. Release 2, menu-selectable data-type validation, the ability to lock multiple rows and columns, and a handful of clever convenience features. For instance, by pressing the dollar sign (\$) instead of Enter to terminate a copy command, you can replicate a spreadsheet formula with all cell references absolute; you don't have to go back and add dollar signs to the



The Framework III desktop, with outline, word processor, and database windows open. Framework now includes full mouse support and color control.

source cell's formula.

Yet another novelty is the program's ability to include text along with numbers in a formula: *Framework III* will accept an entry such as "'280 miles to Las Vegas' / '70 miles per hour'" and return, in this case, the number 4.

The database module hasn't changed significantly, although it now shares with the spreadsheet the ability to validate data entry types.

The outliner sports one major improvement and several conveniences. You can now create multiline outline entries; the earlier *Framework* user had to resort to clumsy workarounds

to achieve a two- or three-line entry.

In addition to these modest improvements to *Framework*'s functional modules, the environment itself has been dressed up. *Framework III* supports VGA in 28- and 50-line text and graphics modes. Colors can be set separately for just about every conceivable display element (including negative numbers in spreadsheet and database frames). Commands, files, and data can be selected by mouse.

The DOS file management services have been greatly enhanced; you can finally use the *Framework* function-key commands to copy and relocate disk directory entries. And, adding to *Framework*'s desirability as a DOS shell, it will now remove all but 9K of itself from memory when you use the DOS Access command; this allows you to run virtually any other program from DOS without quitting *Framework*.

What do all these changes add up to? *Framework III* is a superlative machine for pulling together information. You can grab data from a remote service (Dow Jones, for example), transport it into a spreadsheet or database frame (the numeric text is flawlessly parsed into live cells), and create from the data a graph that's automatically updated as new numbers arrive. You can write reports in the word processor (or import them from *MultiMate*, *DCA*, *WordPerfect*, and other formats), then use the outliner to

assemble everything—words, numbers, and graphs—into a coherent structure.

None of the individual modules sports as many features or rates as strong a performer as the best of its standalone counterparts. But the seamless integration of the modules creates a whole that, for the managerial user, is greater than the sum of its parts.

Unfortunately, there is one major managerial need *Framework III* does not adequately address: presentation-quality output. *Framework* puts the pieces together, but it doesn't make them attractive enough by current standards. For example, the new version provides nominal recognition of the Hewlett-Packard LaserJet, as well as its most popular font cartridges, but you'll find no support for proportional spacing. For graphic output, *Framework III* supports plotters from HP, IBM, and others, as well as the LaserJet and other laser printers. But PostScript is not supported.

These are serious defects in a package aimed at the higher strata of corporate life. One hopes, for the sake of an otherwise brilliant product, that Ashton-Tate will remedy them soon.

## Framework Spreadsheet: Flexibility at the Expense of Speed

The *Framework* spreadsheet is an unusual beast. Long before *Microsoft Excel* was even a Macintosh product, *Framework* offered the ability to link worksheets, to build graphs from data in more than one worksheet, and to write macros that resided in the environment, not in the individual worksheet. And because each *Framework* spreadsheet cell is a separate "frame," each cell can have its own typestyle attributes and can carry its own full-blown FRED program. This makes it easy to highlight important parts of a worksheet with boldface or underlining and to document as-

sumptions and logic.

Unfortunately, because each cell is a frame unto itself, the program creates humongous disk files—about twice the size of similar *Lotus 1-2-3* files—and worksheets that recalculate *s-l-o-w-l-y*. For instance, *Framework III* required 29.4 seconds to recalculate 1,000 exponentiation cells during our performance tests; *Lotus 1-2-3* did the same job in 6.5 seconds. The new selective recalc feature helps, but until true minimal recalc arrives, you'll want to leave major number-crunching to the standalones.

—Craig Stinson



FACT  
FILE

### Framework III

Ashton-Tate Corp.  
20101 Hamilton Ave.  
Torrance, CA 90502  
(213) 329-8000

List Price: Single-user version, \$695 (e-mail requires MHS, from Action Technologies, \$100).

Requires: 640K RAM, two disk drives (hard disk recommended), DOS 2.0 or later.

In Short: An integrated package well suited for management of diverse forms of information. Weak on presentation-quality output. Not copy protected.

CIRCLE 453 ON READER SERVICE CARD



## PackRat

(continued from page 33)

meetings with "tickler" alarms and lead-time alerts, and even delete items automatically when their "purge date" passes. You'll get the most use from it if you make *Windows* your operating environment and keep *PackRat* loaded. Ticklers and alerts appear even if another *Windows* application is running in the foreground.

*PackRat*'s seven lists are the Phone Book, Phone Log, Task List, Agenda List, Expense Log, Index Cards, and Disk File Log. Each list has individual characteristics, but all share the same keyword search capability (up to eight keywords per item). You can perform multiple keyword searches by typing in the keywords or choosing them from a list.

Suppose you're managing an important project. You've logged the related documents and spreadsheets in *PackRat*'s Disk File Log and created attachments from each file to its author. You've broken down the job into tasks and attached each task to the person responsible. In preparation for the project, you did quite a bit of research—your bibliography is stored on Index Cards. Other Index Cards have .TIF (tagged image file) format graphic diagrams attached to them.

Earlier, you set a tickler alarm for today—it pops up, reminding you to start Phase 2 of the project. But, according to the Task List, Phase 2 depends on Phase 1, and Phase 1 isn't marked "Completed."

Selecting "Show Phone Items Attached to Task," you pop up a phone list of people involved in the project. *PackRat* automatically created the list by keying on your task assignments. Another menu choice instructs *PackRat* to dial the first person on the list. *PackRat* immediately opens a Phone Log entry and starts timing your call. During the call you take copious notes (up to 32K), and after calling each member of the team you set up a meeting.

Pointing at the meeting date on the Calendar, you click the left button to see what's sched-

uled. A right-button click on the same date presents an entry form for the Agenda List. You fill in the time and description of the meeting and indicate that you want an alert 20 minutes beforehand. Naturally you also attach the Agenda entry to each person who will be present.

You'll want everything about the project in hard copy, so you specify a Global Search on the project's unique keyword. That gives you one global list containing items from every list except the Phone Book. Print a report from this list and you have an instant handout for your meeting.

*PackRat* doesn't waste your previous efforts to organize information. If you can convert existing structured data into a comma-delimited ASCII file, you can import it into *PackRat*

lists. You can also bring unstructured ASCII text files into the Note field of any item.

Another feature, called Offload/Onload, functions as a built-in backup-and-restore feature. The Offload feature copies all or part of your *PackRat* data to as many floppy disks as needed, and Onload reverses the process.

*PackRat* won't give you the power or flexibility that *Lotus's Agenda* will—provided you have the necessary time to learn and customize *Agenda*. But by tailoring lists to common functions, *Polaris* has created a Personal Information Manager you can start using immediately. And with *PackRat*'s on-line help, both context-sensitive and indexed, you may never need the extensive manual or printed tutorial.



## FACT FILE

### *PackRat*, Version 1.0

Polaris Software  
613 W. Valley Pkwy., # 323  
Escondido, CA 92025  
(619) 743-7800

List Price: \$395

Requires: 512K RAM; hard disk drive; VGA, EGA, or Hercules graphics adapter; Microsoft Windows, Version 2.03 or later (runtime version supplied); mouse optional; DOS 3.0 or later.

In Short: A *Windows*-based Personal Information Manager that offers ease of learning and use at the expense of flexibility.

CIRCLE 448 ON READER SERVICE CARD

# PC Magazine DOS Power Tools

BY GUS VENDITTO

Don't expect an objective review of Paul Somerson's new book, *PC Magazine DOS Power Tools*, in these pages: too many *PC Magazine* editors and contributors poured their inspiration into the DOS tips that stuff this 1,275-page book-and-disk combination for us to be



anything but proud.

Somerson, a former *PC Magazine* executive editor and chief architect of our Productivity section, has summarized the best work-saving utilities and system-tuning batch files to have appeared there in the last few years. All told, 213 execut-

able files are on the disk and are fully documented in the book, including INSTALL/REMOVE (for managing TSR conflicts), QUICKKEYS (to speed cursor movements), and DR (a file manager). And in pursuit of the magazine's goal of helping readers learn while they excel at their jobs, some 15 BASIC programs are included on the disk in order to demonstrate some elementary programming principles.

Much of the book is an exploration of how the various facets of DOS work, all of it original material. There are chapters devoted to files (how DOS creates them and how you can use them more efficiently); PC memory (RAM, ROM, and how the processor juggles them); batch files (with a detailed list of all the commands and the best ways to use them); and much more.

Read from cover to cover, *PC Magazine DOS Power Tools* offers a rich education in the basics of how a PC works—and how to use it to its fullest potential. Yet it was also designed to be skimmed.

In fact, the book serves quite nicely as a replacement for the

DOS and BASIC manuals. You'll find virtually everything here that the manuals cover, with one exception: *PC Magazine DOS Power Tools* was written to be enjoyed.

Somerson has little patience for bad manuals and documentation, and he sets out to prove that mastering your PC doesn't need to be drudgery. This attitude, and the exuberant style it creates, are best exemplified in Somerson's description of the DOS manual: "a fat, inscrutable reference crammed with useless details on how to use Norwegian characters or hook your computer to a nuclear reactor."



## FACT FILE

### *PC Magazine DOS Power Tools*, by Paul Somerson

Bantam Books  
666 Fifth Ave.  
New York, NY 10103

ISBN: 0-553-34526-5

List Price: \$39.95

CIRCLE 488 ON READER SERVICE CARD

# Economical 19-inch Monitor Offers 1,280-by-1,024 Display

## PC HANDS ON

BY JENNIFER ZAINO

At \$1,695, the DesignView/19 Display System, from Elite Business Applications, is a lot less expensive than most 19-inch, black-and-white monitors. What you get for your dollars is a flicker-free paper-white display, a high-resolution video card, and drivers for popular software, including *Microsoft Windows*, *PageMaker*, *Ventura Publisher*, *Lotus 1-2-3*, *Publisher's Paintbrush*, and *AutoCAD*. The price includes future driver upgrades and additions.

The DesignView's 1,280-by-1,024 resolution may not be as high as that offered by others, such as the \$2,400 Sigma Designs LaserView, but it is more than adequate for most purposes—including DTP applications that require the display of two facing pages. The 96-dots-per-inch display capability, as well as a 64-Hz vertical-and-horizontal scan rate, produce a truly WYSIWYG black-and-white image.

The monitor is a Taiwanese-made giant, measuring 17 by 16 by 18½ inches (HWD). The display screen logs in at the reported 19 inches. The 46-pound unit looks sleek standing next to your CPU.

A tilt-and-swivel base is built in; it's an admirable attempt to reduce glare, but without an antireflective coating, there's simply no real escape. Also there is little play in the brightness control; you'll want to turn it up all the way for the most illuminating effect—at the halfway point, the screen becomes a dark abyss.

Designed around Intel's 82786 graphics coprocessor,

the adapter is packed with 512K of video RAM, a ROM chip, and a host of support chips. A connector for a Microsoft Bus Mouse is also included.

The DesignView displays *Windows*- and *GEM*-based programs, such as *PageMaker* and *Ventura Publisher*, in eminently crisp, clear, and legible screens. The company's claim that you can read even 6-point text is true, but it's a stretch.

The DesignView seems similarly well-suited for *AutoCAD* applications. You get a clean image, without smearing or lineal distortions.

The PC Labs tests showed the 8-bit DesignView board's BIOS emulation routines to be slow, but it performs well in its native graphics mode.



In the case of DTP applications, big is really beautiful. The DesignView's 1,280-by-1,024 resolution provides a crisp screen display.

# \$249 Pravda on CD-ROM: All the News That's Officially Fit to Print

## PC HANDS ON

BY DONALD B. TRIVETTE

Remember the old childhood riddle: What's black and white and red all over? The answer is *Pravda*, the official newspaper of the Soviet Union's ruling Communist Party, full-text copies of which are now available on CD-ROM from Aide Publishing.

Aide's *Pravda on CD-ROM* disk contains the English translation of 5,800 articles that appeared in *Pravda* during 1987.

You'll find everything from weather reports ("minus 20°C in Moscow tonight with light winds") to television listings ("7:00—Morning Exercises, Cartoons, and Music. 7:30—Time. 8:05—Everyone Love the Circus. 8:40—Heroes of S. Mikhailov on the Screen...").

The disk was mastered with a search index of more than 100,000 unique words, so you can quickly scan for any subject. I was astonished to see that my own state made *Pravda* twice—once as the return ad-

dress on a letter to the editor, and again in a short article about archaeologists uncovering the remains of a ship that sank off the North Carolina coast centuries ago. There were considerably more articles about personal computers—40 in all—but I could find nothing about the IBM PC.

Once indexing is complete, an updated disk containing both 1986 and 1987 data will be sent free to purchasers of the current disk. *Pravda on CD-ROM* is an ongoing project, and 1988 text will be available in 1989.

## PC FACT FILE

### DesignView/19 Display System

Elite Business Applications Inc.  
4201 Remo Crescent Dr.  
Bensalem, PA 19020  
(215) 639-9567

List Price: \$1,695

Requires: 128K RAM, IBM PC, XT, AT, 386, PS/2 Model 25, 30, or compatible; DOS 2.1 or later.

CIRCLE 436 ON READER SERVICE CARD

The DesignView includes a CGA emulation for DOS applications. A nice touch: the system uses a double-scan technique to blow up 12-point-type characters to 20 points.

The product ships with utilities that let you switch between high- and low-resolution applications in multitasking environments.

And one of the best things about the DesignView is its 3-year warranty on parts and labor. The company also offers a 60-day money-back guarantee—but the system is so good you probably won't need to take advantage of the offer.

## PC FACT FILE

### Pravda on CD-ROM

Aide Publishing  
4830 W. 77th St.  
Minneapolis, MN 55435  
(612) 835-5240  
List Price: \$249

Requires: 512K RAM; PC and CD-ROM player; Microsoft CD-ROM Extensions; one disk drive. Not copy protected.

CIRCLE 435 ON READER SERVICE CARD

*Pravda* is a wonderful tool for the CIA, libraries, and serious Kremlinologists. For the rest of us, it's a fascinating look at how news is presented in the Soviet Union.



**BASICS**

Roman  
Helvette  
Rockland  
Chancellor

**BASICS II**

*Roman Italic*  
Amertype  
**Big City**  
Optimis

**DECORATIVE**

**Coop**  
Abbey  
**Beget**  
Oma

**BOOK**

Garamet  
Basque  
Centrum  
Palatine

**SANS SERIF**

Avanti  
**Gillies**  
Olivia  
Galaxy

**FIXED**

Courier  
Prestige  
Letter Gothic  
Line Draw

**G**lyphix LaserJet fonts can save you hours of downloading, megabytes of storage and thousands of dollars. And they're simple to use in Microsoft Word 4.0 because of our unique font management software.

Glyphix fonts are generated "on the fly" from within Word. Just pick your fonts from the format character menu and when you print, your selections are created and down-loaded to the printer, in seconds.

Microsoft Word's new font menu supports up to 128 fonts because the bigger your LaserJet font library the better. And Glyphix helps you take advantage of this expanded capability.

Glyphix fonts work right alongside Bitstream and Hewlett Packard soft fonts and that's important because using the right typeface can be as important as choosing the right words.

# Microsoft Word Font Special.

**A Special Offer:**

A set of four Glyphix fonts costs just \$99.95. Now you can afford to add professional style and impact to all of your Word documents, letter,

memos, reports and presentations.

Start building your LaserJet font library today.

**Order the Glyphix MS Word Font Manager and any set of four Glyphix fonts at our regular price and we'll send you a second set of four fonts, absolutely free! Don't wait, this offer ends November 1, 1988.**

Glyphix fonts require an IBM PC, AT, XT, PS/2 or compatible with 64K RAM; a hard drive; LaserJet Plus, Series II or compatible printer; MS-DOS 2.0 or later. Glyphix lets you print up to 30 point type on a LaserJet Plus and up to 60 pt. on a Series II without additional memory. Glyphix Font Managers are available for Microsoft Word and Word Perfect 4.1, 4.2 & 5.0. Glyphix fonts work with most popular word processing software, Ventura Publisher and Aldus Pagemaker.

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	Address _____		
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# \$59 SpinRite Prevents Hard Disk Data Loss, Optimizes Hard Disk Performance

## PC HANDS ON

BY EDWARD MENDELSON  
AND CRAIG L. TARK

Few messages chill the heart more quickly than "Sector not found" or "Unrecoverable read error." *SpinRite*, the \$59 hard

disk before that catastrophic moment when DOS can no longer read them at all.

With most disk-controller combinations, *SpinRite* will perform an on-the-fly low-level format and optionally change the interleave for better throughput. The low-level for-

command. In rare instances it will declare them usable and offer to unlock them for data storage. You're free to accept or reject the offer. Although *SpinRite*'s testing is thorough enough to allow you to restore these sectors with confidence, you'll sleep better if you refuse to use any sectors that have shown problems.

If you turn off all testing, *SpinRite* can low-level-format a 30MB disk in less than 15 minutes. But a full testing and reformatting session can take as much as 10 hours, so *SpinRite* allows you to suspend its operations and then resume them later at the point where you left off. Full progress reports are available on-screen and from the printer.

*SpinRite* works with all normal disk-encoding formats, but it will refuse to low-level-format a disk used with an RLL controller that masks the true number of sectors per track. The current version also won't handle disk partitions larger than 32MB.

mat refreshes the magnetic information—which can be easily disturbed by temperature changes and other factors—that defines the tracks and sectors on your disk.

But *SpinRite*'s main claim to fame is its ability to make an end run around DOS and directly detect disk errors that DOS normally conceals. All hard disk controllers are able to correct small errors by themselves. Once the controller corrects them, DOS throws away all information about the errors. Other testing programs either ignore errors hidden by DOS or try to detect them by indirect methods.

In contrast, when you install *SpinRite* by booting from a copy of the distribution disk, it finds the memory location where the controller in your machine passes information to DOS. It then configures itself to elbow in ahead of DOS and look for errors at that memory location.

*SpinRite* tests sectors already marked "bad" and locked out by DOS's FORMAT



FACT  
FILE

### SpinRite

Gibson Research Corp.  
22991 La Cadena  
Laguna Hills, CA 92653  
(714) 830-2200  
List Price: \$59

Requires: 192K RAM, DOS 2.1 or later.

In Short: A powerful testing and repair program for hard disks. Not copy protected.

CIRCLE 447 ON READER SERVICE CARD



*SpinRite* clearly reports the progress and results of its disk scanner surface scans via a disk track map and annotated codes.

disk testing and repair utility from Gibson Research, can keep your heart warm by keeping your data readable. *SpinRite* can also adjust the interleave on a disk to make both disk and controller deliver the fastest speed possible. Lucid menus and a detailed manual make all the program's functions accessible even to the most cautious novice.

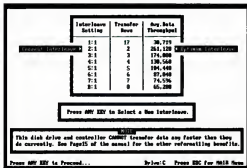
*SpinRite* starts out by performing benchmark tests on your disk, including a test for the optimum interleave. It also checks the physical characteristics of the disk and the coding method used by the controller—either standard MFM or a more advanced coding technique like RLL. It then exercises the disk by writing up to 84 test patterns to each byte and checking for errors.

While testing each disk track, *SpinRite* keeps the data from that track in memory and moves it to a safe area if it finds problems. Because *SpinRite* can detect errors that DOS ignores, it blocks off shaky areas of your

about the rest appear in the manual. But you'd be wise to back up all your data before using any disk-manipulation program as powerful as this.

In use, *SpinRite* located some 12 previously unmarked bad sectors among the three partitions on an 80MB Seagate; two sectors with its easiest test level, the rest with its deepest level of analysis.

*SpinRite*'s best-known rivals among disk-testing programs are Prime Solutions' *Disk Technician* (\$99.95) and *Disk Technician Plus* (\$129.95, supports RLL drives). Prime Solutions



*SpinRite* determines the optimum interleave setting for your hard disk subsystem and can change the interleave without destroying your data.

Some versions of DOS, like Zenith's special DOS through Version 3.1, and some controllers (notably those sold by Seagate), won't let the program run at all, but no damage is done. Meanwhile, the program detects almost all incompatibilities, and large-type warnings

has not submitted *Disk Technician Plus* for review. Both *Disk Technician* versions are copy protected and offer less options and information than *SpinRite*. Prime Solutions' secretiveness about its techniques is one of many reasons I prefer to trust my disks to *SpinRite*.

C>ERASE \*.\*

Are you sure (Y/N)?\_

« Data Guardian »

# New Disk Optimizer gives you the courage to say yes!

## Introducing Disk Optimizer 4.0. Now with Data Guardian™ and Undelete.

It's the moment of truth.

You've decided to erase an entire directory, and your computer asks, "Are you sure?"

Well? Are you? Is it the right directory? Will you ever want these files again?

Enter new Disk Optimizer 4.0 with Data Guardian. The only disk utility software that lets you blithely say "yes" now, and if you want, change your mind later. Because only Data Guardian ensures that anyone can Undelete files, directories, even entire disks. And do it hours, days, up to weeks later, no matter what else you've written to your disk in the meantime.

Best of all, Data Guardian makes file recovery quick, easy and totally fool-proof. Without the complexity of other data recovery software. And without the uncertainty. Thanks to Data Guardian, Disk Optimizer comes through for you every time.

### You formatted what drive?

That's fine for erased files, you say. But what happens if you accidentally format your hard disk? No problem.

Disk Optimizer comes through again with UnFormat that can instantly restore all the data on your disk to exactly where it was before that little slip of the finger on the keyboard.

And to make sure your data is really safe, the TrackSaver feature protects the surface of your disk from excessive wear by preventing the head on your drive from spinning over the same track for too long. And the Refresh program prevents the bad spots that develop on disks due to fading magnetic charges.

### Still the safest buy in performance optimizers.

As always, Disk Optimizer also gives you the safest, most advanced performance optimization available—proven by over a quarter of a million users.

The Optimize program speeds up disk reading and writing times by up to 300 percent by un-doing the file fragmentation that takes place

naturally over time. The DOConfig program lets you arrange the layout of your disk for best overall performance. And the Analyze program gives you a graphical look at the condition of your disk, so you'll always know when it's time to optimize again.

### A total of 17 different programs.

Disk Optimizer includes Findfile for locating files by name or wildcard anywhere on your disk. Sorts for re-arranging files and directories in the way that makes sense to you. Lock and Unlock for password-protected file security. Killfile for erasing sensitive data permanently. And lots more.

In all, there are 17 different programs in the new Disk Optimizer. Each one designed to improve performance, guard your data, and make disk management easier and simpler for everyone.

So get new Disk Optimizer 4.0, and get more than the courage to say yes. Get the peace of mind and total confidence that your disk is running better and safer all the time.



**Optim�zer** \$69<sup>95</sup>

SoftLogic Solutions, Inc.  
One Perimeter Road, Manchester, NH 03103.

Available at software dealers everywhere.  
Or, order direct by calling toll-free.

**Call 800-272-9900**  
(603-627-9900 in NH)

CIRCLE 334 ON READER SERVICE CARD

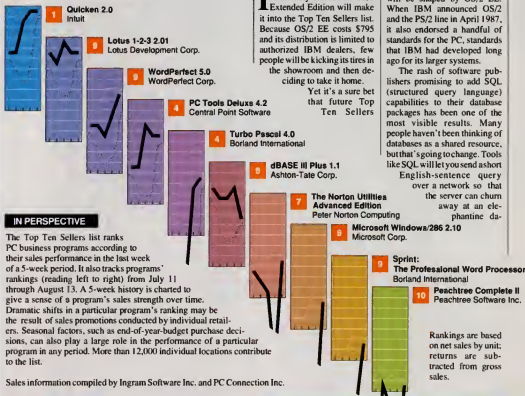
**SOFTLOGIC**  
SOLUTIONS



# PIPELINE

## TOP TEN SELLERS

(A 5-week history)



## IN PERSPECTIVE

The Top Ten Sellers list ranks PC business programs according to their sales performance in the last week of a 5-week period. It also tracks programs' rankings (reading left to right) from July 11 through August 13. A 5-week history is charted to give a sense of a program's sales strength over time. Dramatic shifts in a particular program's ranking may be the result of sales promotions conducted by individual retailers. Seasonal factors, such as end-of-year-budget purchase decisions, can also play a large role in the performance of a particular program in any period. More than 12,000 individual locations contribute to the list.

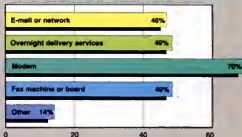
Sales information compiled by Ingram Software Inc. and PC Connection Inc.



## SURVEY

As the fax revolution continues rippling through American business, it's closing in on the modem as the preferred way to send documents in PC-equipped offices. The DCA/Intel Communications Application Specification (see next page) may accelerate that trend, because clearly the need for efficient transmission devices is there. Of those who responded to this survey on PC MagNet, 68 percent said they send important PC-generated documents to locations outside their offices.

**How do you send PC-generated information from place to place?**  
(Please answer with all that apply.)



tabase until your answer is found, sparing your machine the need to retrieve the entire file when all you need is a small piece of it. (See "SQL: An Emerging Database Standard for PCs," *PC Magazine*, May 17, 1988.)

Writers of network software were given yet another reason to build APPC (advanced program-to-program communications) and LU 6.2 protocol awareness into their products (although many workgroup systems providers, like DCA, have been making healthy additions to the genre for years now). IBM's initial implementation of APPC and LU 6.2 was unwieldy and required too much memory. But IBM's commitment to fold it into OS/2 EE means that its visibility will grow dramatically.

And, of course, SAA (systems application architecture) standards for how a program looks and talks to other programs are affecting all manner of programs. The effects are often totally cosmetic, but they still provide the intended result of making software easier to use. SAA had been around before OS/2 was announced, but its use throughout OS/2 is proof that IBM is serious about mak-

ing links among PCs, minis, and mainframes easier.

It all adds up to a DEC-like harmony among separate computer lines. As one IBM product manager summarized OS/2 EE's goals: "Every time

Extended Edition is expected to arrive any day for its first PC Labs test. Keep an eye on First Looks for our evaluation and the answers to many of the questions early news of OS/2 EE has raised.

### Soon we'll see a word processor with a "fax" option: without closing your document, the word processor will activate a fax transmission.

you change the wire out of the back of the box, you don't want to have to change the user interface. We think we've achieved that."

Now that OS/2 EE has started to ship, other vendors will soon be trying to deliver the goods that IBM promised. Both Lotus and a Microsoft/Ashton-Tate partnership have said they'll deliver the kind of SQL server OS/2 EE has. The great unanswered question is, will these competing implementations speak the same language? And will IBM make specific use of the Micro Channel architecture, as it has hinted it would?

**A Major Boost for Background Communications?** Speaking of standards, Intel is pulling one out of its hat, and it arrives with the blessing of virtually every major software publisher.

Intel's Communications Coprocessor is, at heart, a fax board with file transfer and e-mail capabilities built around a 10-MHz 80188 processor. Right now the board will communicate with only its own kind, but DCA announced that it has begun development on an IRMA implementation.

The board uses the DCA/Intel Communications Application Specification, a newly cre-

ated protocol for sending files over phone lines from within applications.

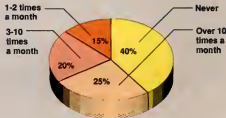
Because the board has its own processor for communications, background transfers shouldn't degrade foreground activity. Intel supplies software to manage e-mail, fax, and file transfers, but the board's potential won't be realized until software publishers build hooks for the board into their programs.

Lotus, Ashton-Tate, Borland, Symantec, and other publishers say they're willing to try to make this vision work, so soon we will see, for instance, a word processor that will have a "fax" option: without even closing your document or calling a TSR, the word processor will activate a fax transmission. If you received a document from a fax machine, you'd be able to work as it arrived and then call it up without ever having to run communications software.

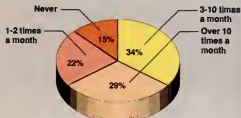
It's an ambitious vision, but clearly appealing. Right now Intel offers an optional Hayes-compatible modem on a daughtercard to use until the day when all your communications can be done in the background with a coprocessor.

—Gus Venditto

**How often do you use fax machines or boards to transmit PC-generated documents?**



**How often do you use modems to transmit PC-generated documents?**



# PICK UP A \$20,000 ANSWERING SYSTEM FOR \$349.



## **INTRODUCING THE COMPLETE ANSWERING MACHINE. IT TURNS ANY PC INTO A POWERFUL VOICE MAIL SYSTEM.**

Now you can turn any PC into a powerful voice mail system.

Without interfering with your normal computing.

It's called The Complete Answering Machine. And it is the most sophisticated, affordable voice mail system you can buy.

## **IT'S A FULL-FUNCTION VOICE MAIL SYSTEM.**

The Complete Answering Machine gives you 999 individual private voice mailboxes, each coded by a password. It takes messages, forwards messages to other phones, delivers messages at pre-scheduled times, just like a private receptionist. You can even record private messages for specific callers.

And of course you can retrieve messages remotely from any touch-tone phone.

## **IT RECORDS DIGITALLY.**

Like the most expensive voice mail systems, The Complete Answering Machine records right on your hard disk. You'll be amazed at the clarity of reproduction.

It even has sophisticated built-in voice prompts to guide your callers through the options they have in leaving messages.

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# THE COMPLETE PC

CIRCLE 264 ON READER SERVICE CARD

# OverDrive Streamlines Your Multiple-Document Mail-merges in WordPerfect

## PC HANDS ON

BY JUDY HOUSMAN

Packets of standard documents are standard business fare. Unfortunately, most word processors do better at customizing mass mailings than at filling in the blanks in a set of related documents. Even *WordPerfect 5.0* is no exception—without the help of *OverDrive*, that is.

To use *OverDrive*, you select the *WordPerfect* merge documents from the *OverDrive* library menu. The program then examines the blank fields in your documents and generates an easy-to-use data entry screen. An item of information need be entered only once—no matter how many times the field appears in the separate documents.

Once the data has been entered, *OverDrive* generates sophisticated *WordPerfect* macros and calls up *WordPerfect*. You

then invoke this menu-driven macro system to assemble and print the documents you've selected. You can also examine and modify documents individually if you wish.

Frequently used combinations of documents can be collected in a single reference file;

you can then handle the documents as a group. *OverDrive* also lets you insert one or more boilerplate paragraphs into a document.

TurboSoft supplies more than 70 forms and legal documents in *WordPerfect* format, ranging from a will to an offer of



*OverDrive scans the merge fields of each document and creates a data entry screen.*

## FACT FILE

### OverDrive, Version 1.1

TurboSoft  
23811 Chagrin Blvd., #260  
Cleveland, OH 44122  
(216) 292-3425  
List Price: \$99.95  
Requires: *WordPerfect 4.x* or  
5.0; 512K RAM; hard disk  
drive; DOS 2.0 or later.

CIRCLE 437 ON READER SERVICE CARD

employment. Depending on your printer, it can even fill out forms for Federal Express and other delivery services.

Of course, you can add your own documents to the *OverDrive* menu, but this takes several steps and can be quite complex.

*OverDrive* does a nice job of streamlining a common and tedious task. Though versions are now available for only *WordPerfect 4.x* and 5.0, additional versions are planned for *Microsoft Word*, *MultiMate*, and *WordStar Professional*. **PC**

# 10NET Plus: Everything PC LAN Can Do Plus E-mail and Group Scheduling

## PC HANDS ON

BY FRANK J. DERFLER, JR.

*10NET*'s latest networking software, *10NET Plus—Token-Ring Version*, is designed to go head-to-head with IBM's *PC Local Area Network Program* over IBM's Token-Ring hardware and win on points.

*10NET Plus*'s screens, menus, and features represent an improved version of the older *10NET*. But while *10NET* runs only on *10NET* interface cards, *10NET Plus* is designed to run over NetBIOS so that you can load it over IBM's LAN Support Program (IBM's latest name for its NetBIOS services) and use it instead of *PC LAN* on Token-Ring cards.

We ran *10NET Plus* over

IBM Token-Ring cards using the IBM LAN Support Program. Benchmark tests showed *PC LAN* and *10NET Plus* in a virtual tie for performance. In 15 tests performing a variety of random and sequential reads and writes, *10NET Plus* averaged 179 kilobits per second throughput, and *PC LAN* averaged 175 kilobits per second. Both were configured for maximum performance in the server role.

A station acting as a server under *10NET Plus* used about 209K for DOS, NetBIOS, and the LAN program (without e-mail). This is about 100K less than a similarly configured *PC LAN* installation.

In theory, you can run *10NET Plus* over any vendor's network interface cards and the

same vendor's NetBIOS.

As an experiment, we ran *10NET Plus* over LANtastic cards using NetBIOS from the LANtastic vendor, Artisoft; the combination worked fine. No guarantees, but *10NET Plus* should run over other "well-behaved" NetBIOS implementations.

*10NET Plus* includes a new electronic-mail package with every feature you could wish for. This e-mail is a version of the popular *Network Courier* package. The chat and network diagnostic utilities now present themselves in screen windows for a more modern appearance. *10NET* has always had good print spooling utilities and one of the best group calendaring programs we have seen.

*10NET Plus—Token-Ring*

## FACT FILE

### 10NET Plus—Token-Ring Version

10NET Communications  
7016 Corporate Way  
Dayton, OH 45449-4223  
(513) 433-2238  
List Price: Software only,  
\$395. NetBIOS software bundled  
with 10NET cards, \$695.  
Requires: 192K RAM, one  
disk drive per workstation;  
396K RAM, hard disk drive for  
server; IBM's LAN Support  
Program; DOS 3.3 or later.  
Copy protected.

CIRCLE 432 ON READER SERVICE CARD

Version retails for \$395 per node. This is more than twice as much as *PC LAN*, but *10NET Plus* gives you a great e-mail package and many useful utilities missing from *PC LAN*. **PC**





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And hope you're not one of their neighbors.

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# SoftJET: LaserJet Screen Preview Utility

## PC HANDS ON

BY EDWARD MENDELSON

*SoftJET*, Theta Systems Corp.'s \$120 preview program, lets you see on-screen almost exactly what you'll get when you print a file to a LaserJet. The preview screen displays graphics, shading, lines, and fonts, and you can zoom in to see the same 300-dot-per-inch resolution the LaserJet provides.

You can't use *SoftJET* to modify a file; you have to go back to the program that created the file. But that's just another way *SoftJET* imitates the LaserJet: you can't modify a file by marking up the printed output, either.

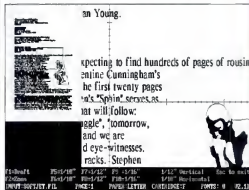
You first "print to disk" from your application, then run *SoftJET* either as a pop-up or standalone. A small page display appears with greeked text. A zoom window shows fonts in their true shape.

Fonts on cartridges are load-

ed into *SoftJET* from "image files" on-disk. Early copies of *SoftJET* came with image files for the now-obsolete B and F cartridges; by the time you read this, Theta Systems will supply image files for the Z cartridge instead. Image files for other cartridges cost \$19.95. You won't need an image file for soft-

fonts, because the program creates screen fonts directly from the font files on-disk.

The version we reviewed emulated only portrait printing on the LaserJet Plus. A version including landscape previews and full support for the added functions in the LaserJet II was promised for late summer.



You use *SoftJET*'s zoom feature to display fonts in their true shape.

## PC FACT FILE

### *SoftJET*

Theta Systems Corp.  
307-2150 W. Broadway  
Vancouver, B.C.  
Canada V6K 4L9  
(604) 732-4323

List Price: \$120

Requires: CGA, MCGA, EGA, VGA, or Hercules graphics, DOS 2.0 or later. Not copy protected.

CIRCLE 430 ON READER SERVICE CARD

*SoftJET* can save the time that might be wasted in test graphics printouts. With non-WYSIWYG programs like text formatters, you can save the 3 cents per page it costs to print a trial copy. Or you could use a program like *WordPerfect*, Version 5.0, which has graphics-based print preview built in.

# Sysgen Bridge-File/Bridge-Tape: A Cure for the Floppy-Drive Blues

## PC HANDS ON

BY WINN L. ROSCH

IBM has turned the PC into a multimedia extravaganza and blessed us all with headaches as we try to cope with two floppy disk sizes and four formats. In its Bridge-File family of products, Sysgen offers one of the best ways to move files among these formats.

The Bridge-File lineup includes internal and external high-density 5¼- and 3½-inch floppy disk drives (\$325) and a DC2000 tape backup system called Bridge-Tape (\$695). A series of adapters makes all units compatible with the full IBM line, from PC to Model 80.

Each Bridge-File is a complete disk subsystem with full hardware and software support.

In addition, the hardware multiplexing built into the Sysgen adapters and their special driver software allows any computer to handle as many as four floppy disk drives (one of which can be the tape backup system). Connectors on the back panels of Bridge-File units let you daisy-chain the units with the cable supplied with the drive.

PCs and XT's require little adaptation to accept a Bridge-File—just installation of the included connector cable—but only the low-capacity mode of the drives (360K and 720K) can be used if you go that route. You'll probably want to opt for Sysgen's \$80 four-drive replacement controller, which supports high-density formats and their fast, 500-kilobit-per-second data transfer rate.

ATs get an adapter card that

requires one expansion slot. A 37-pin D-shell connector on the adapter bracket connects by cable to the Bridge-File. PS/2 Bridge-File systems include a \$70 adapter that replaces the IBM floppy disk drive adapter, allowing a cable for the external drives to run to a similar connector on an expansion-slot retaining bracket.

One of the supplied Sysgen utilities will tell you what letter your system has assigned to each of your Bridge-File drives. Another allows earlier versions of DOS to format otherwise incompatible disks.

The tape system is incompatible with the floppy-controller-based QIC-40 standard. Its software has full backup, restore, verify, and format options, and it packs up to 42MB per tape while permitting three

## PC FACT FILE

Bridge-File/Bridge-Tape  
Sysgen Inc.  
556 Gibraltar Dr.  
Milpitas, CA 95035  
(408) 263-4411

List Price: Internal or external 5¼- or 3½-inch floppy disk drives, \$325; external DC2000 tape subsystem, \$695; four-drive controller for high-density formats in PCs and XT's, \$80; AT and PS/2 adapter, \$70. Requires: DOS 2.1 or later.

CIRCLE 431 ON READER SERVICE CARD

error-correction levels (0, 5, or 100 percent redundancy).

The Bridge-File drives are reasonable in price and in size; all external units fit in 2- by 6- by 9½-inch steel cases. If you need to move files between formats, Bridge-File will do the job for you.

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Databases Advisor,  
June 1988

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\*\* Requires an 80286/80386 PC with 800KB RAM plus either 1MB of extended memory (running DOS 3.2 or 3.3) and a hard disk. \*\*\* Licensed for development only. Same hardware requirements as ORACLE for 1-2-3. \*\*\*\* Licensed for development only.

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# Command Post Takes Tedium out of Windows with User-Defined Menus

PC HANDS ON

BY BARRY SIMON

Microsoft Windows' graphical interface provides a friendlier environment than the blank-screen world of DOS, but Windows suffers from problems of its own. Clicking to numerous subdirectories to start your favorite applications can be tedious; moving your mouse through a long list of .PIF files to find the one you want can be equally annoying. What you'd like is a menu that lets you start your applications by clicking on the application name.

Wilson WindowWare's *Command Post*, a shareware Windows application, lets you create a menu that does precisely that. It also provides other powerful features that Microsoft doesn't.

*Command Post* begins by hijacking the MS-DOS Executive. The Executive's display is still there, as are its menu options, but the window's name changes to *Command Post*, and several additional menu choices are added to the menu bar. Two are extra *Command Post* functions. The other additions are

menus you design yourself.

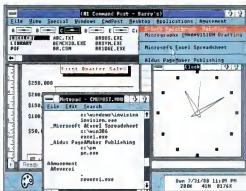
Designing a menu is simple. You specify the menu choices and the commands each choice is to invoke using *Command Post* menu-definition files. A sample menu-definition file serves as an excellent model for creating your own menus.

If you have a number of open windows stacked on one another in Windows itself, getting to the one you want can be a nuisance. One of *Command Post*'s features lets you list all open

windows and choose from that list. You can arrange all open windows by stacking in an orderly way or arranging in non-overlapping arrays.

*Command Post* sets up Ctrl-Shift-Esc as a hotkey that calls its window to the top at any time, so its services are always readily available.

*Command Post* also provides a screen blanker. Since the blanking is done by opening a full-screen black window, it is hardware-independent and safe



*Command Post* enables you to create or alter its Windows menus by editing menu-definition files with the Windows Notepad.

PC FACT FILE

*Command Post*, Version 4.9

Wilson WindowWare  
3377 59th St. SW  
Seattle, WA 98116  
(206) 938-3191

List Price: Shareware: basic license fee, \$20; with disk (including on-disk documentation), \$25; with printed documentation and disk, \$50.

Requires: System running Microsoft Windows, Windows/286, or Windows/386.

CIRCLE 433 ON READER SERVICE CARD

to use on any monitor.

My only complaint with *Command Post* is that it is active mainly inside Windows applications, as opposed to oldapps (DOS applications running within Windows). That's because Windows itself relinquishes much of its control when an oldapp is running. As a result, you won't be able to hotkey to *Command Post* from within an oldapp.

All in all, however, *Command Post* is more than worth its \$25 price (for disk and on-disk documentation). If you use Windows as a multiprogram environment, this package is one Windows application you definitely shouldn't be without. [E]

# Software du Jour Gathers Public-Domain Shareware Greats on \$30 Compact Disk

PC HANDS ON

BY DONALD B. TRIVETTE

A CD-ROM has at last broken the \$30 barrier, which is the contemporary equivalent of a good 5-cent cigar. And this cigar is indeed good.

Alde Publishing has released *Software du Jour*, a CD-ROM containing 365 public-domain programs for home, office, school, and entertainment. Although it doesn't have even a tenth of the programs available

on another Alde product, the \$99 CD-ROM, this disk has been distilled and refined to include only the best.

Mastered using the High-Sierra format, the disk functions like a giant write-protected floppy disk. Programs are organized into five subdirectories: Business, Computer, Home, School, and a special subdirectory containing some of Jim Button's popular shareware programs, including *PC-DIAL*, *PC-FILE Plus*, *PC-TYPE Plus*, and *Extended DOS*. Each sub-

directory has a text file with a short description of its contents.

The Business subdirectory has separate directories for *dBASE*, *Lotus 1-2-3*, *Stocks*, and *Write*—the latter containing two word processing programs and a spelling checker. The programs in the Lotus subdirectory are nothing to get excited about, but the *dBASE* section is more interesting. It has an order entry and inventory control program, a tracking system for legal clients, and dozens of *dBASE* utilities.

PC FACT FILE

*Software du Jour*

Alde Publishing  
4830 W. 77th St.  
Minneapolis, MN 55435  
(612) 835-5240

List Price: \$29.95

Requires: CD-ROM player and High-Sierra CD-ROM Extensions. Not copy protected.

CIRCLE 434 ON READER SERVICE CARD

*Software du Jour* is a real breakthrough for people who distribute and use public-domain software. [E]

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**INFO** THE  
**WORLD** PC NEWS WEEKLY

## REPORT CARD

### SOFTWARE BEDFORD INTEGRATED ACCOUNTING

**7.6**

	Unacceptable	Poor	Satisfactory	Very Good	Excellent
Performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ease of Learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Error Handling	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### REPORT CARD SOFTWARE BPT ENTRY ONE ACCOUNTING

**5.9**

	Unacceptable	Poor	Satisfactory	Very Good	Excellent
Performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ease of Learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Error Handling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### REPORT CARD SOFTWARE DAC-EASY ACC VERSION

**6.4**

	Unacceptable	Poor	Satisfactory	Very Good	Excellent
Performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ease of Learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Error Handling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### REPORT CARD SOFTWARE PEACHTREE COMPLETE BUSINESS ACCOUNTING

**6.7**

	Unacceptable	Poor	Satisfactory	Very Good	Excellent
Performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ease of Learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Error Handling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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*InfoWorld, Nov. 16, 1987*

\$249 Suggested List

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CHOICE  
SEPT. 1986

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## NEW ON THE MARKET

by Jonathan Matzkin

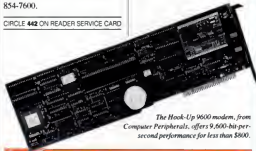
**Computer Peripherals  
Unveils Internal 9,600-  
bps Modem for \$795**

Today's exotic new PC product is tomorrow's commonplace tool. The Hook-Up 9600, from Computer Peripherals Inc., is an internal 9,600-bit-per-second modem that retails for \$795. The AT-bus-compatible modem is compatible with the Hayes AT command set, as well as the Bell 103 J and 212A standards. It also supports the CCITT V.22- and V.22bis-compatibility standards. The modem comes with communication software and operates in either asynchronous or synchronous transmission modes. It has auto-dial, auto-answer, and auto-redial capabilities, in addition to remote operation and auto-failback.

**List Price:** Hook-Up 9600, \$795.

**Requires:** Standard bus expansion slot. Computer Peripherals Inc., 667 Rancho Conejo Blvd., Newbury Park, CA 91320; (800) 854-4600.

CIRCLE 442 ON READER SERVICE CARD



The Hook-Up 9600 modem, from Computer Peripherals, offers 9,600-bit-per-second performance for less than \$800.

**Sanyo Laptop Packs  
Two Floppy Disk Drives  
In an 8-pound Package**

Sanyo's \$1,599 MBC-16LT laptop is the lightest two-floppy-disk-equipped portable around, the company says, and at 7 pounds, 14 ounces, it very well may be. It runs an 80C88 processor at clock speeds of 8 MHz or 4.77 MHz. Standard are 640K RAM, two 3½-inch 720K floppy disk drives, and one serial and one parallel port.

The display is a 9-inch supertwist LCD, that can be ad-

The \$149 PC Mouse II, from MSC Technologies, has a sleek new shape and nine different cursor-speed settings.

**MSC Optical Mouse  
Has High-Resolution**

MSC Technologies (formerly Mouse Systems) has engineered a new rodent—the PC Mouse II—that gives you control over resolution that can be varied from 20 to 2,000 counts per inch. The two-button optical mouse is priced at \$149 and features an eye-catching, completely redesigned case.

The mouse comes with *Ultra-Res 2000*, a software utility that offers nine different speed settings for the screen cursor. Other standard software includes an automatic install program, menuing software, and a paint program. MSC says the



**HOT  
PROSPECT**

**NEC Debuts Desktop and First  
Portable to Run Intel 80386SX Chip**

Compaq Computer Corp. was first out of the blocks with a system that uses Intel's long-awaited 80386SX, or P9, processor, but NEC Information Systems is hard on Compaq's heels with two new machines of its own. The \$4,495 NEC PowerMate SX is a desktop system, and the \$6,595 NEC PowerMate Portable SX is a lunchbox-style transportable. Both machines run the 32-bit-internal/16-bit-external processor at a clock speed of 16 MHz, and they come with 2MB RAM. The base systems have either a 1.2MB (desktop model only) or a 1.44MB floppy disk drive, and a 40MB hard disk.

The new NEC PowerMates accommodate up to 16MB RAM, 10MB of which may consist of 80-nanosecond chips. Also standard are one RS-232C serial port and one parallel port. The systems support a NEC-customized version of the Microsoft OS/2 Standard Edition,

PC Mouse II is plug compatible with the Microsoft Mouse.

**List Price:** PC Mouse II, \$149. MSC Technologies Inc., 47505 Seabridge Dr., Fremont, CA 94538; (415) 656-1117.

CIRCLE 445 ON READER SERVICE CARD

and *Microsoft Windows/386* will be included free as an introductory offer.

The desktop version offers six expansion slots (five 8/16-bit, one 8-bit) along with one 3½- and two 5¼-inch half-height internal disk bays.

The PowerMate Portable features three full-size 8/16-bit expansion slots, an RGB monitor interface, and an external 5¼-inch floppy disk drive interface. The standard gas plasma screen supports VGA graphics and displays 16 shades at up to 640 by 480 resolution. The PowerMate Portable SX weighs 21 pounds and measures 11.2 by 7.6 by 15.7 inches (HWD). **List Price:** NEC PowerMate SX, base system \$4,495. NEC PowerMate Portable SX, \$6,595. NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (800) 343-4418.

CIRCLE 438 ON READER SERVICE CARD

NEC Information Systems unveils systems based on the new Intel 80386SX processor.



justed for best viewing angle. The screen is detachable, and the machine will support an external monitor.

The Sanyo MBC-16LT runs for up to 6 hours on a single charge of its nickel-cadmium battery pack, according to Sanyo. DOS 3.2 and GW-BASIC 3.2 are included.

**List Price:** Sanyo MBC-16LT, \$1,599. Sanyo Business Systems Corp., 51 Joseph St., Moonachie, NJ 07074; (201) 440-9300.

CIRCLE 446 ON READER SERVICE CARD



## NEW ON THE MARKET

## Freedom of Press: PostScript Language Brought to Ink Jets and 24-Pin Printers

Custom Applications Inc. has introduced *Freedom of Press*, a \$495 software package that brings the PostScript page description language to 24-pin dot matrix and ink jet printers as well as to laser printers. Supported lasers include the HP LaserJet Plus Series II, the Canon LBP-II, the Olivetti PG-108, and the J Laser card. The Hewlett-Packard DeskJet, the Siemens PT-88S and PT-90/12, and the Canon BJ-130 ink jet printers can also exploit *Freedom of Press*. The package works with 24-pin dot matrix printers from IBM, NEC, Epson, Fujitsu, and Tandy.

*Freedom of Press* includes 35 fonts and a font-scaling system for infinite sizes. Two versions of the software are available; one uses Bitstream's

Fontware and typefaces, and the other uses Compaggraphic's *Intellifont* and their typefaces.

The package has an automatic printing feature that is compatible with a number of programs, including Xerox's *Ventura Publisher*, Aldus's *PageMaker*, and *WordPerfect*. Other applications can use *Freedom of Press* to print files individually or in batch mode.

**List Price:** *Freedom of Press*, \$495. **Requires:** 80286 processor, 640K RAM (570K RAM free), 5MB EMS RAM, parallel port, hard disk drive, supported printer. Not copy protected. ©Custom Applications Inc., 5 Middlesex Technology Center, 900 Middlesex Tpk., Billerica, MA 01821; (800) 873-4367.

CIRCLE 441 ON READER SERVICE CARD

## Hardware Lock Blocks Unauthorized Use of An IBM PS/2 Model 50

The \$49.95 PS/2-LOK, from **Qualtec Data Products Inc.**, is intended to provide a measure of security for users of IBM's PS/2 Model 50. The lock controls access to the system's power switch; a key is required to turn the switch on or off. The PS/2-LOK is secured to the Model 50 with a retainer plate,

and Qualtec says that no special tools are required for the lock's installation.

An optional master keying feature (\$4) allows overall access control for designated individuals.

**List Price:** PS/2-LOK, \$49.95. **Requires:** IBM PS/2 Model 50. Qualtec Data Products Inc., 47767 Warm Springs Blvd., Fremont, CA 94539; (415) 490-8911.

CIRCLE 444 ON READER SERVICE CARD

## Yamaha Offers DOS 80286-based Laptop For Composing Music

The PC can make beautiful music, but making it sing usually involves searching out and installing a variety of optional hardware. So the Digital Musical Instrument Division of **Yamaha Corp.** has introduced the 80286-based *Yamaha C1*, a DOS portable that comes standard with much of the hardware that would be MIDI musicians need.

The C1 comes with 11 MIDI jacks (two in, one through, and eight out), and SMPTE in-and-out jacks. An additional system timer—not used by the main computer—is included for use by music software designers. Two front-panel sliders can be programmed to control such music parameters as pitch bend, volume, and tempo, among others. The C1 also features ROM-based music fonts, which are accessed from music-symbol keys on the keyboard.

The C1 is available in a



The *Yamaha C1* (\$3,995 with 20MB hard disk) comes with much of the hardware that MIDI musicians need.

\$3,995 20MB hard disk version and a \$2,995 dual 3½-inch, 720K floppy-disk configuration. It comes with 1MB RAM; there is also an optional 1.5MB



RAM expansion board. Two serial and one parallel port are standard. The display is a backlit LCD with maximum resolution of 640 by 400. The C1 weighs 18.1 pounds, Yamaha says.

**List Price:** *Yamaha C1*, with 20MB hard disk, \$3,995; with two floppy disk drives, \$2,995. Yamaha Music Corp. USA, P.O. Box 6600, Buena Park, CA 90622; (714) 522-9011.

CIRCLE 443 ON READER SERVICE CARD

## ReadStar II Plus and OmniPage Packages Improve Page Scanners' OCR Capabilities

*ReadStar II Plus*, from **Innovative**, and *OmniPage*, from **Caere Corp.**, allow supported page scanners to recognize a wide variety of typefaces, font sizes, and graphics.

*ReadStar* recognizes any typewritten, typeset, or printed font with normally contrasted images, *Innovative* reports. *ReadStar* uses artificial intelligence to "learn" new typefaces for immediate or future use. The \$4,500 package works with proportional or monospaced fonts with point sizes of between 4 and 20 points, depending on print quality. Claimed accuracy is up to 99.9 percent, at a rate of up to 1,300 words per minute. The program stores scanned text in ASCII format. Compatible scanners include those from Microtek, Canon, Hewlett-Packard, IBM, and Ricoh.

*OmniPage* lets scanners handle a page regardless of the mix of images and fonts, *Caere* says. The \$1,995 combination hardware-and-software application can import scanned text and images into a variety of word processing, graphics, and desktop publishing formats, including ASCII, *WordStar*, *WordPer-*

*fect*, and *Microsoft Word*.

The first version of the software comes with drivers for the Hewlett-Packard ScanJet and the Canon IX-12 Image Scanner. These drivers allow scanning of text and/or images in a single pass, and *OmniPage* also recognizes pages stored in TIFF format from other scanners, according to *Caere*. Users can search scanned text; insert and delete text blocks; and crop, copy, and paste scanned images.

**List Price:** *ReadStar II Plus*, \$4,500. **Requires:** 640K RAM; Hercules or EGA graphics; hard disk drive (80286 processor strongly recommended); scanner; DOS 3.1 or later. Not copy protected. *Innovative*, 1911 N. Fort Myer Dr., #708, Arlington, VA 22209; (703) 522-3053.

CIRCLE 439 ON READER SERVICE CARD

**List Price:** *OmniPage*, \$1,995. **Requires:** DOS 3.0 or later; expansion slot for included coprocessor card. Software not copy protected. *Caere Corp.*, 100 Cooper Ct., Los Gatos, CA 95030; (408) 395-7000.

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# AskSam 4.0 Adds Hypertext

## PC HANDS ON

BY NEIL J. RUBENKING

The latest version of *AskSam* balances neatly on the edge between free-form text managers and traditional structured databases. Version 4.0 adds indexing, context-sensitive help, a hypertext feature, and enhanced file and output handling. And despite these added functions, it will still run on a 256K single-floppy-disk-drive PC.

*AskSam* doesn't require explicit keyword lists or fields in its data. Any text is acceptable, whether created in the *AskSam* editor or imported from another format. And any word in the text can be a search target.

However, to refine queries, you can use *fields*—implicit, explicit, and contextual. Implicit fields are simply related items that begin with the same character sequence. Explicit fields have field names, and square brackets delimit their data—for example, "[NAME] John Doe"].

The Before and After commands let you treat any ordinary word as a contextual field. "[BEFORE] CA" would return the names of California cities in your database—or anything else appearing immediately before "CA".

*AskSam* makes simple queries easy. Searching for text that contains a single phrase involves only specifying that phrase.

Complex queries can pro-

duce reports equivalent to those of structured databases, complete with headers, footers, subtotals, and grouping. You'll have to master a fairly complex query language to generate such reports, however.

The new hypertext feature works in three ways. In a hypertext menu record, you move a lightbar around the screen to various items. Select a filename and *AskSam* loads that data file. Select a program name and it



Using the lightbar and hitting Enter calls up descriptions of *AskSam* features.

## PC FACT FILE

*AskSam*, Version 4.0

AskSam Systems

P.O. Box 1428

Perry, FL 32347

(800) 3ASKSAM

List Price: \$295; \$50 upgrade

for owners of Version 3.0; ten-

station network version, \$895.

Requires: 256K RAM; DOS

2.0 or later. Not copy pro-

TECTED.

CIRCLE 450 ON READER SERVICE CARD

runs the program. Select anything else and *AskSam* executes the selection as a query.

Version 4.0 can also index a file. You index on a single field. The index is a part of the data file, so there's no chance of losing it. This latest version also adds three levels of security.

*AskSam*, Version 4.0, is a major step in the evolution of an unusual product. Once you learn its command language, you gain the power of a structured database without having to define specific fields.

# A \$59.95 Sideways Challenger

## PC HANDS ON

BY DONALD B. TRIVETTE

An old dance? A new laundry detergent? The latest in zany parlor games? No, *Twist & Shout* is the latest in sideways and banner printing software from The Software Toolworks.

*Twist & Shout* is really two programs. *Twist* is the program that takes a DOS file or spreadsheet and prints it sideways down the page; *Shout* performs a similar service, letting you create and edit messages that can be printed as banners. Both programs have menu-driven point-and-shoot interfaces similar to *Lotus 1-2-3*'s.

*Shout* sizes its letters to fit the number of message lines and the paper size. For example, on 8½-inch-wide paper with one

line of text, *Shout* produces a banner with letters 8 inches high. With four lines of banner text the letters are automatically scaled to 2 inches high.

*Shout* can mix any of its four type fonts—Old English, Sans Serif, Times Roman, and Script—within a line or even a word. And the same is true for colors, assuming you have a color printer. There's a symbol font with images like footprints, a lightning bolt, a crescent moon, various arrows, a birthday cake, and a variety of animals. If you can't put together an attention-grabbing banner with this program, it won't be the software's fault.

*Twist* is designed for those times when you wish your printer had a 12-foot carriage. It takes an ASCII text file as input and rotates the text 90 degrees to

print lengthwise along the page. The number of lines down the page—now really across—depends on which of the 15 type sizes you select; they range from tiny (120 lines/page) to extra large (30 lines/page).

*Twist & Shout* supports more printers and more fonts per printer than *Sideways*—the popular sideways printing package for *Lotus 1-2-3*. *Twist & Shout* has bigger big fonts and smaller small fonts than the reigning king, *Sideways*, on the other hand, can place borders around a spreadsheet and can speed printing with its logic-seeking print routine.

A special interface for *Lotus 1-2-3* lets *Twist* work within a spreadsheet as an add-in product. The *Twist* install program automatically takes care of putting the proper files in the sub-

directory with 1-2-3 and attaching the add-in manager. To print a spreadsheet with 256 columns, for example, you invoke *Twist* using a hotkey, mark the range to print, and select the print command from the submenu. You lose about 60K of memory to the add-in software, but that's 20K less than *Sideways* demands.

The Software Toolworks is so confident of its product that it guarantees *Twist & Shout* will work with any dot matrix printer—or it will make it work. The program supports the HP LaserJet printer in native mode, and most other laser printers in a dot-matrix-emulation mode.

List Price: *Twist & Shout*, \$59.95.

Requires: 384K RAM, supported

printer, DOS 2.0 or later. Not copy

protected. The Software

Toolworks, One Toolworks Plaza,

13557 Ventura Blvd., Sherman

Oaks, CA 91423; (818) 907-6789

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# "Most people we meet who give Paradox a try, end up switching to it"

Mark Cook and Steve King, Data Based Advisor



## Here's what Data Based Advisor had to say about Paradox:

"You'll find creating a Paradox database easy ... The real test of a DBMS isn't how easy it is to enter your data, but how easy it is to query that data, rearrange it, and perform calculations with it.

"The Paradox Query by Example (QBE) system allows you to easily structure queries from two or more databases ..."

## Even novices create applications without programming

"Any Paradox user, even a novice one, can easily use the Personal Programmer to generate menu-driven Paradox applications ... The Personal Programmer works well all the time, even with long, complex applications. We found it can really simplify application development."

"Finally, as the frosting on the applications developer's Paradox cake, it'll only cost you \$9.95 to buy the run-time version of Paradox to distribute [unlimited] copies of your application."

## Macros save programming time

"What's really nice about Paradox macros is this: the program records them in the Paradox Application Language (PAL). Once you've recorded a macro, you can name it, save it, and re-use it. But best of all, when you start programming with PAL, you can include your macros as part of your PAL code, really saving programming time."



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## Paradox gives you true concurrency on your network

"You'll find using Paradox on a network is exactly like using the stand-alone version. The real power of the Paradox NetPack shows itself when you simultaneously access a database being used by other people ... The program elegantly handles all the chores of a multiuser database system with little or no effort by network users. Along with allowing you to almost instantly see changes made by other users, Paradox has very powerful automatic record locking features."

## Report Generator is a joy to use

"If you've ever suffered with creating dBASE III PLUS reports, you'll find the Paradox Report Generator a real joy to use ... The Report Generator allows you to create headers and footers and to place fields wherever necessary to get the appearance you want."

## Paradox is the one we choose!

"One of us is a confirmed Paradox user who has used the software since the beta-version of Paradox 1.0. The other just learned to use Paradox for this evaluation; he's decided to give up dBASE and switch."

*Excerpts from Mark Cook and Steve King's review of Paradox in Data Based Advisor, January 1988.*

## See your Paradox dealer today

Your dealer can tell you more about the Paradox that's right for your environment: Paradox 2.0 for standalone or network users; Paradox 386, optimized for your 80386-based hardware; or new Paradox OS/2, coming soon to get the most from OS/2!

60-Day Money-back Guarantee\*

\*Customer satisfaction is our main objective; if within 60 days of purchase this product does not perform to your satisfaction with our claims, call our customer service department, and we will arrange a refund.

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# IBM's Mainframe-wise, PC-simple Graphics

## PC HANDS ON

BY JENNIFER ZAINO

In some ways, IBM's *DisplayGraphics* packs a lot of punch. Companies whose workstations are tied to IBM's System/370 will appreciate the \$650 package's ability to exchange graphic picture and chart files with mainframe applications. The program stores its picture files in .PIF format, which is consistent with some System/370 applications.

However, removed from the mainframe world, its faults may outweigh its advantages.

To start with, *DisplayGraphics* is a memory hog, requiring 640K of base and 512K of expanded memory. There is no direct support of the emerging computer graphics metafile (.CGM) standard, or for .TIF, .PCX, or .PIC formats.

For a program that requires a mouse, entirely too much emphasis is placed on the keyboard. An example: to save a file, you must first type in the filename, next hit the Enter key, and then click mouse button two. Add to this a very crowded, very blue screen, and searching for menu options becomes about as easy as finding a parking place at the mall on Christmas Eve.

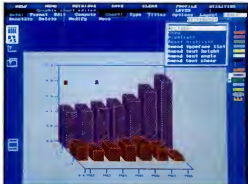
You'll do most work in separate text and graphics charting

modules. The text charting module includes options to create plain, bulleted, and numbered lists, as well as tables.

In the graphics charting module, you can create bar, pie, surface, line, scatter, needle, and sundry other chart types—including Venn diagrams and polar histograms.

You can type your own text

While you can perform operations such as changing the colors of objects, or the height, angle, or shear of the text in either the text or chart editor, it is only in the graphics drawing editor that you can add images from the program's 1,000-piece clip-art library, or draw in circles, boxes, polylines, or just do your own freehand drawing.



IBM's *DisplayGraphics* includes an option to create 3-D tower charts. These enhanced versions of bar charts allow you to compare your data in two directions.

or graphics data directly into the program, but you can only import data directly from ASCII, .DIF, or .SLK files. You can manipulate your graphics data to find sums, coefficients, and standard deviations, but moving data from one column or row to another is clumsy.

One of *DisplayGraphics*'s most relevant features is its ability to change the default profile to one that reflects your tastes. And the layering feature allows you to merge up to five files into one picture file.

Other features, while considerable, are marred. For in-

stance, you can choose from among 66 typefaces, but not all of them are legible on-screen.

The program supports the EGA, VGA, and 8514/A graphics adapters, so you always have a choice from among a 16-color palette (as well as 16 fill patterns). But since the program is geared to support vector output devices such as plotters, *DisplayGraphics* does not include options to mix and create your own color palettes.

Users hooked to a System/370 mainframe will no doubt find *DisplayGraphics* a valuable product. But this is a costly and rather deficient program for the individual user.

## PC FACT FILE

### DisplayGraphics

IBM Corp.

Call your local authorized IBM dealer.

List Price: \$650

Requires: 640K RAM; 80286/80386-based IBM PC, 512K expanded memory, hard disk drive, 5 1/4-inch high-capacity or 3 1/2-inch 1.44MB disk drive; EGA, VGA, 8512, 86/513, or 8514; mouse; DOS 3.3 or later.

CIRCLE 451 ON READER SERVICE CARD

# MyBase: Simple Database Package That Specializes in Pocket-size Printouts

## PC HANDS ON

BY DONALD B. TRIVETTE

If you're looking for a way to put a database in your pocket, *MyBase*, from Useful Software, may be the answer. *MyBase* was designed to print database output in a compact form.

Any half-witted database can print its contents, but *MyBase* has a variety of unique formats including a billfold, rotary

card, Day-Timer, and the *MyBase* Reference Book form, which resembles a vest-pocket checkbook. The package comes with vest-pocket forms, and the software prints from the inside out—so that when everything is folded and inserted into the cover, the A's are at the front and the Z's at the back.

Since *MyBase* prides itself on its import and export features, I thought it would be easy to import my *Hot Line* tele-

phone file. The first problem was that the printer setup procedure was incorrect for my printer. The second problem was that *MyBase* doesn't understand *Hot Line*'s ten-digit long-distance telephone numbers. Once I got around the first two problems—technical support was most helpful—I printed the directory. The result was cluttered and difficult to read; *MyBase* insists on underlining every entry, and it isn't flexible enough to

turn underlining off.

*MyBase* is a fine product if you want to do exactly what the developer wants you to do, but it clearly lacks flexibility and imposes some odd restrictions. You must have a hard disk, for example, to import data. *MyBase* may be your base, but it's not my base.

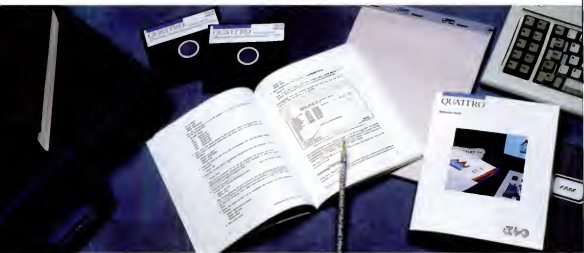
List Price: *MyBase*, \$89.95.

Requires: 384K RAM, two disk drives, printer, DOS 2.0 or later. No copy protected. Useful Software, 22704 Ventura Blvd., #145, Woodland Hills, CA 91364; (818) 880-9128.

CIRCLE 452 ON READER SERVICE CARD

# "Those who are considering purchasing 1-2-3 will be better off with Quattro"

—John Walkenbach, InfoWorld



## Here's what InfoWorld had to say about Quattro

"There are some clear advantages in choosing Quattro over the 1-2-3 of today: easier installation, no copy protection, improved speed, much better macros, excellent graphics, a customizable command interface, and direct compatibility with industry standard file formats. If cost is a factor, you can get five copies of Quattro for the same money that would buy two 1-2-3 packages."



### Quattro Includes SQ2! Plus data compression

A special implementation of SQ2! Plus, the spreadsheet file compression utility, is built into Quattro and comes to you absolutely free. SQ2! Plus for Quattro automatically compacts and expands Quattro spreadsheets by up to 95% during file saving and retrieving.

Registered with trademark from Borland.

\*Customer satisfaction is our main concern. Within 60 days of purchase, this product does not perform as advertised, we will refund your money. No questions asked. All other software companies require you to return the product. We have no return policy on hardware. All other software companies require you to return the product. We have no return policy on hardware. All other software companies require you to return the product. We have no return policy on hardware.

## Features: Improving the Industry Standard

"Quattro takes the industry standard and improves upon it in the areas that count most. It addresses many of the weaknesses of 1-2-3 and adds quite a few of its own unique touches."

"Perhaps Quattro's main advantage over most other spreadsheets is its minimal recalculation capability. When you make a change in your spreadsheet, only affected cells are recalculated, greatly speeding things up in most cases."

"Other Quattro features that improve upon the 1-2-3 standard include auto-record macros, vastly superior graphics, and easy installation."

## Performance: Markedly superior to 1-2-3

"Our benchmark tests show Quattro markedly superior to 1-2-3 in file saves and retrieves."

"Quattro's graphics are a sight to behold."

"Quattro makes working with macros practically painless. If you're into complex 1-2-3 macros, the debugging feature alone is good reason to make the switch to Quattro."

"No one can argue that Quattro is anything less than an excellent spreadsheet value."

*Excerpts from John Walkenbach's review of Quattro in InfoWorld, January 11, 1988.*

**60-Day Money-back Guarantee\***  
Includes 3½" and 5¼" disks.

**CIRCLE 137 ON READER SERVICE CARD**

For the dealer nearest you or a brochure call (800) 543-7543



# Business Forms That Mean Business

Isn't it frustrating? You need all kinds of forms to run your business. With a PC on your desk, why are you still doing forms by hand? Now with **FormWorx**, and **FormWorx with Fill & File**, you have two ways to streamline your forms processing. Save time. Save money. Get down to business.

## FormWorx.™ Get the forms you want.

Invoices, expense reports, tracking sheets, records, logs, and schedules. Whether it's a form you use a thousand times or a one-of-a-kind, you can make it with **FormWorx**. Start from scratch or modify one of the many forms we've already created for you.

**Business forms that look business-like.** Draw vertical and horizontal lines—single, double, and thick—with just a single keystroke. Lines print perfectly straight and solid on dot matrix and laser printers. Type and edit text. Large, wide, and condensed type sizes. Underline, boldface, center, justify, reformat, alter case, and more.

**It's easy to change your mind.** Stretch or shrink a form. Erase, copy, and move things around until every detail is just right. Sort and resort a list, search for a word, etc. There's even an "Undo" command for those times when the computer does what you say instead of what you mean.

**The fastest and easiest forms generator on the market.** Period. Intuitive pull-down menus and clear commands allow you to create your first form soon after opening the package. It's that simple.

### The critics are unanimous:

*"FormWorx makes it easy to create forms. Inexpensive...easy to use."* **The Wall Street Journal.**

*"The user interface is first rate. Editing is especially easy. The documentation is well written, comprehensive, and easy to understand."* **PC Magazine.**

### And users agree:

*"A great product is only half the story. You look at FormWorx also have that ingredient which is missing with so many products on the market today—customer service. You take care of your customers like few in the industry do today—and the customers keep coming back with their friends."* **R.D.W., Lexington, S.C.**

## NEW! FormWorx with Fill & File.™ Fill out forms perfectly.

All the features of **FormWorx** plus powerful **Fill & File** software that lets you easily fill out the same form again and again. Perfectly Standard government and industry forms. Armed forces, real estate, insurance, health care, law, education... **Form template shows on screen for easy fill-in.** Simply tab from one blank to another and just type. Your typing stays in the blanks and the form is protected against accidental overwrites. Easily edit your entries and get letter-perfect printouts every time.

**Lets you print only the data onto pre-printed forms.** Perfect alignment every time. Or if you prefer, print the form and the data onto blank paper. Either way, you can use search conditions to batch print only those forms you need.

**Minimizes retyping.** "Lookup" lists help you type frequent entries automatically. "Demo" repeats what you typed before. Date, time, and serial number "stamps" will save you precious time. And fixed data can be preserved in "Read-only" fields.

**Stores data in a database file for later use.** Just retrieve the information whenever you need it for that form...or any other form. Store up to 32,000 records in a single file. Easily locate and update specific records.

**Reads and writes dBASE III Plus™ (DBF) files directly** so the data on your forms can be used to generate reports, summaries, mailing labels, form letters, etc. Easily create a form for loading information into your dBASE files. Or quickly make a form for viewing selected information in those files. ASCII and other file formats are also supported.

**Fill & File even does the math!** Included free: **FormWorx Programming Language.**

Automates forms processing in your office.

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In Mass. 617-890-4499

**FormWorx**  
CORPORATION

Reserve Place, 1601 Trapelo Road, Waltham, MA 02454

Hardware requirements: Over 125 printers supported. Requires IBM PC, PS/2, or compatible with DOS 2.0 or higher. FormWorx—\$29.95, FormWorx with Fill & File—\$12.95. Works with or without a graphics board. Color is displayed on color systems. Available on 3.5" disks when specified. Not copy protected.

Prices and terms subject to change without notice. Trade-up rebate offer expires June 30, 1988. FormWorx and Fill & File are trademarks of FormWorx Corporation. dBase III Plus is a trademark of Ashton-Tate.

**Special Offer!** FormWorx is just \$95! FormWorx with Fill & File is just \$149! Each package includes dozens of ready-to-print forms, an easy-to-read manual with tutorials, and FREE telephone support.

**Yes! Send me** ☐ FormWorx ☐ FormWorx with Fill & File

☐ Please charge to my

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Signature \_\_\_\_\_

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Company \_\_\_\_\_

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Telephone (\_\_\_\_\_) \_\_\_\_\_

☐ Enclosed is my check or money order.

Make checks payable to **FormWorx Corp.**

Shipping and Handling in US/Canada:

**FormWorx—\$4.75. FormWorx with Fill & File—\$6.75.** Air mail overseas: **FormWorx—\$10. FormWorx with Fill & File—\$18.** In MA add 5% sales tax.

### 45-Day Money Back Guarantee!

If for any reason you are not satisfied, call our customer service department to arrange for a prompt refund. Direct purchases only.

## PC UPDATE

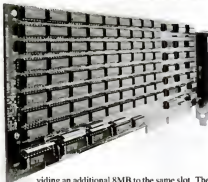
by Paula Seefeldt

**Professional File Adds "Look Up" Feature**

Software Publishing Corp. has added a "look up" capability to *Professional File*, its database management program. Version 2.0 can access numeric values, string values, dates, and texts from related files, including *dBASE* files. Additional new features include the ability to create custom menu-driven applications and to validate data as it is entered. *Professional File* 2.0 retails for \$299. Upgrade information for registered users will be available after August 30, 1988. Software Publishing Corp., Mountain View, Calif.; (415) 962-8910.

**Attention<sup>2</sup>: Gains 16MB of Memory**

*Attention<sup>2</sup>*, from Newer Technology, adds up to 16MB of high-speed AT extended memory to an AT-bus-compatible system. *Attention<sup>2</sup>* allows from 1 to 8MB of memory to be installed, with a companion daughterboard pro-



viding an additional 8MB to the same slot. The board is available in socketed and factory-populated configurations for 256K or 1MB RAM chips. A 256K board retails for \$1,380, and the 1MB-chip version is \$1,520. Newer Technology, Wichita, Kans.; (316) 685-4904.

**WordPerfect Upgrades Product Line**

WordPerfect Corp. is now shipping the network version of *WordPerfect 5.0*. New features include the ability to combine several documents into one file and to compare and revise an on-screen document with an existing disk file. *WordPerfect PC LAN 5.0* retails for \$695 with an extra cost of \$150 for each additional station. *WordPerfect Library 2.0* provides enhancements to the Calendar, Calculator, File Manager, Notebook, and Program Editor. Updates are available for \$40 (including documentation) or \$20 (diskettes only). New packages retail for \$129. *WordPerfect 4.2* for SCO Xenix includes 24 on-screen columns, line numbering, and a document comments/summary feature. Retail price is \$995. WordPerfect Corp., Orem, Utah; (801) 225-5000.

**Xerox Advances Ventura Publisher**

Xerox has announced an expansion of the *Ventura Publisher* series. The three-part package includes *Ventura Publisher*, Version 2.0, *Professional Extension*, and *Network Server*. *Ventura Publisher* 2.0 offers 250 context-sensitive help menus, TIFF file compatibility, and gray scale image control. *Professional Extension*, designed for power users, provides complete WYSIWYG equation generation and the ability to create long documents using EMS. *Network Server* supports 3Com, Novell, *PC-NET*, and serialization for each workstation. Updates are available for \$85. *Ventura Publisher* 2.0 retails for \$895. *Professional Extension* costs an additional \$395, and *Network Server* is \$400. Xerox Corp., Rochester, N.Y.; (716) 427-5400.

**Zenith Z-386: Less Memory and Lower Price**

Zenith Data Systems has reduced the standard memory in its Z-386 models from 2MB to 1MB and lowered the retail prices. The Z-386 Model 80 now retails for \$6,399, the Z-386 Model 40 is \$5,499. The Z-386 Model 160 will be reduced to \$7,999 in mid-September. Kits with 1MB and 4MB are available for users who require over 1MB of memory. Zenith Data Systems, Glenview, Ill.; (312) 699-4839.

**For the International Market . . .**

Pinetree Software has incorporated two languages into the *Maximizer* professional productivity system. The bilingual version of the *Maximizer* allows users to switch between French and English and enables LAN users to work in both languages. The *Maximizer* retails for \$395 for the single user and \$895 for a four-user LAN system. Pinetree Software, Richmond, B.C., Canada; (800) 663-0375 . . .

NAME	ADDRESS	TELEPHONE	FAX	TELETYPE	TELEX	POSTAL CODE	CITY	STATE	COUNTRY
Pinetree Software	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada
Maximizer	11111 Highway 101	(604) 271-1111				V1B 1B1B1	Richmond	B.C.	Canada

The *Maximizer* works in French and English text.

Maynard Electronics is now offering a French-language version of the Maynard MaynStream tape backup system. The 20MB version retails for \$1,335, the 60MB version is \$1,635, and the 150MB package is \$2,235. The tape backup system is also available for the PS/2 for an additional \$100. Maynard Electronics, Casselberry, Fla.; (407) 331-6402.



# Others offer the Ordinary in

## *Northgate speaks quietly and Delivers Screaming Performance!*

**What good is splashy color advertising** when the systems others sell don't come near matching the performance or price of Northgate's blazingly fast Turbo Throughput™ family of Computers?

Don't let color ads color your perspective. Northgate advertises its systems in monochrome. We give you facts, everything

you need to make a meaningful comparison.

*And what we save in mono ads is another way we help keep your cost at rock bottom. (You'd be amazed at what color ads cost).*

Hollow claims? Typical Computer Industry Puff? Well, take a look for yourself and see what the Experts say

**READ WHAT PC MAGAZINE SAID ABOUT NORTHGATE'S 386\***

### FIRST LOOKS

## **Northgate Power 386: Premium Performance at a Bargain Price**

**PC HANDS ON**

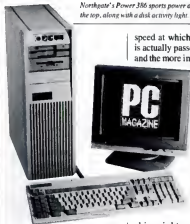
BY BILL O'BRIEN

Field-leading 386 performance just got cheaper. Northgate Computer Systems' Power 386 rivals the power of the Compaq Deskpro 386/20 at a fraction of the cost.

The Power 386 is an upright, 20-MHz floor model with a base price of \$4,295—including a high-performance 65MB hard disk.

A 64K static RAM memory cache deserves much of the credit for the Power 386's performance. Like the Deskpro 386/20, the Power 386 maintains a high-speed, 32-bit path to memory, separate from the I/O bus.

Whereas the 386/20 makes use of Intel's sophisticated cache controller chip, however, the Power 386 falls back on a direct-map static RAM system composed of discrete logic components. Compaq's solution no doubt earns it memory



access performance gains in some cases, but the Power 386 won't be far behind.

The hard disk drive does not have an overly spectacular track-to-track access time—28 milliseconds—but that is a mechanical measurement of disk capability. Data throughput, the

speed at which the information is actually passed across the bus and the more important measure of performance, rates as spectacular when hard disk caching is enabled. But even without caching, the large- and small-record times for the PC Labs benchmark tests rank the Power 386 machine right up there with the Compaq Deskpro 386/20.

The standard configuration includes a 14-inch monochrome monitor, one 5¼-inch 1.2MB floppy disk drive, and one 3½-inch 1.44MB floppy drive. That leaves you with one empty half-height bay.

Whether you purchase

### **PC FACT FILE**

#### **Northgate Power 386**

Northgate Computer Systems  
13895 Industrial Park Blvd.,  
#110  
Plymouth, MN 55441

**List Price:** With 1MB DRAM, 64K SRAM cache, one 5¼-inch 1.2MB floppy disk drive, one 3½-inch 1.44MB floppy disk drive, 65MB hard disk, monochrome monitor, \$4,295.

**In Short:** The Power 386 delivers top performance and intelligent design at an excellent price.

this 386-based machine for its price tag or for its performance, the chances are that you won't be disappointed. Watch *Microsoft Windows* load quickly for a change, or observe a pull-down menu snap up like a runaway window shade, and you will finally get an honest feel of what speed is all about.

\*NOTE: Reprinted in full without editing, to give you the complete picture.

© PC Mag., July 1988, 207 Data Communications Co.

## **OTHER EXPERTS AGREE...**

Steve Gibson, *InfoWorld*, 3/21/88

"It's no coincidence that (the) 386 Northgate Tower is Steve's Dream Machine... (it is) the best possible personal machine for the least possible money."

Computer Shopper, 6/88

"The Northgate 386 Tower is an impressive system. Operating approximately eighteen times faster than the original PC..."

# S-C-R-E-A-M-I-N-G Color Ads

386  
Northgate Power  
20 MHz  
complete system

**\$4295<sup>00</sup>**

Northgate  
286/12  
Complete system

**\$2199<sup>00</sup>**



## BOTH SYSTEMS INCLUDE ALL THESE FEATURES:

- 65MB Hard Drive/16 Bit Controller for Turbo Throughput Performance
- Both 1.2 and 1.44 Floppy Drives (read and write all formats) • 1MB RAM
- 14" Paper White Flat Screen Monitor • DOS 3.3 • Vopt • Disk Catching!

Plus... The Spectacular OmniKey/102 Keyboard at no extra cost (See Ad on Page 269).

Compare Anywhere!

**FEATURE-  
FOR-FEATURE**

Your Computer Dollars

**Simply Buy More**

When You Buy NORTHGATE

### STANDARD on both 286 & 386

- |  |  |
|--|--|
| • 1 megabyte RAM                                     | • Hercules compatible graphics card with parallel port |
| • 8 slots—6 16-BIT and 2 8-BIT                       | • I/O card w/ 1 parallel, 1 serial                     |
| • 80287 socket                                       | • 16 bit memory expansion to 16 meg                    |
| • Setup in ROM                                       | • MS-DOS 3.3 & GW-BASIC                                |
| • RLL "Turbo Throughput" 65 Megabyte Fixed Disk      | • Hard Drive caching                                   |
| • 1.2m 5.25" DUAL DENSITY Floppy                     | • Golden Bow VOPT disk optimizer                       |
| • 1.44m 3.5" DUAL DENSITY Floppy                     | • Northgate OMNI KEY/102 keyboard                      |
| • 14" flat screen monitor (choice of white or amber) | • One year limited warranty                            |

### STANDARD in 386

- |                                      |
|--------------------------------------|
| • 84K-0 Watt Static HARDWARE CACHE   |
| • UPRIGHT CASE (Desktop optional)    |
| • TRUE 32 bit Double Sigma processor |
| • Dallas Real time clock             |
| • 80387 support available            |

### OPTIONS for 286 & 386

- |                               |                     |
|-------------------------------|---------------------|
| • 20MHz (for 286)             | \$499 <sup>00</sup> |
| • RAM upgrades to 16 Megabyte | call                |
| • EGA                         | \$499 <sup>00</sup> |
| • EGA+                        | \$799 <sup>00</sup> |
| • Larger, Faster RLL drives   | call                |
| • Monitor: EISA drives        | call                |
| • Internal Tape Backup        | \$499 <sup>00</sup> |
| • External Tape Backup        | \$699 <sup>00</sup> |
| • Co-processors               | call                |
| • Game Ports                  | \$29 <sup>00</sup>  |
| • Second Serial port          | \$39 <sup>00</sup>  |
| • Extended Warranty           | call                |
| • On-Site Maintenance         | call                |

Countless Fortune 500 Companies (List on request), Colleges, Universities and Government Agencies regularly buy Northgate Systems. They've discovered Northgate delivers more bang for the buck!

Industry-leading performance (we can prove it) at unbeatable prices make Northgate the new leader in state-of-the art computer performance technology. If you're spending your money, don't you owe it to yourself

to make us prove our claims?

All Northgate Systems are backed by our unique "OVERNIGHT BY AIR AT OUR COST" policy on any failed components; One-year Limited Parts AND LABOR warranty. Tech Service on systems is free and unlimited.

Once you discover for yourself that Northgate means what it says in our ads, you too will choose Northgate.



Purchase orders on approved credit, pre-pay and company or personal checks (allow 10 days for clearance).

12866 Industrial Park Blvd., Suite 110  
Plymouth, MN 55441



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Hours: M-F 8 a.m.-7 p.m. CST, Sat. 9 a.m.-2 p.m. CST

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## COMMUNIQUÉS

edited by Bill Howard



## RAMIS/PC USER DIES, KEEPS JOB.

Let's say it is 4:45, even if the clock says 3:53. The reason you can "continue to turn our report after report" with the RAMIS/PC Workstation report writer even if "you're abruptly called away . . . to that big computer room in the sky," as this On-Line Software International ad claims, might have something to do with the fact that the Printer is loaded with paper that's already printed before it reaches the printer. You can't see it in this black-and-white reproduction, but the original ad notes that you can get a free 18- x 25-inch reprint by calling (800) 642-0177.

## Change Forms Without Bending Over

Finding and changing multiple forms in your printer can be a hassle. The Form Manager holds up to 3 forms in position for instant feeding. Simply slip the Form Manager's pads under the back of your printer. Feed 3 forms up to 16" wide thru the rubber retainer rollers. One way rollers hold forms in place until you are ready to feed the form into your printer. Rollers allow paper to feed forward thru

Recommended for use with RAMIS software, as shown, forms fed through the \$24.95 Forms Manager from Pryor Catalog Sales Corp. will print on the wrong side.

## Add a Math Chip, You've Got a Cray

"Currently, Farmington's public works garage is converting from the microcomputer to an IBM PC, which offers larger capacity, better speed and flexibility, and mainframe capabilities."

—Public Works magazine, November 1987

## Tone-deaf

To reach the technical support staff for Borland's *Quattro*, callers on Borland's automated phone system were asked to press 1-2-3. Recently it was changed to 1-2-2.

2400 BAWD  
1/2 GARD MODEM

Internal Hayes Compat. **\$139.95**  
By PB

2400 BAUD  
EXTERNAL MODEM

Hayes Compat. **\$169.95**  
By PB

In addition to being cheaper, these internal modems provide ready access to adult bulletin boards. (Fry's Electronics, Sunnyvale, Calif.)

## What Do the Expensive Models Cost?

"Hewlett-Packard Co., expanding its presence in the low-priced plotter market, introduced a new series of plotters for use by architects and engineers . . . They sell for \$22,900 to \$27,500."

—The Wall Street Journal, June 3, 1988



"Come on Brickman. You should know as well as I do that now scanning is one of our best defenses against any unauthorized access to personal files."

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■ BILL MACHRONE

# SHAREWARE OR SCAREWARE?



*Is shareware a viable distribution medium or a leftover from the Age of Aquarius? What will its proponents do next, and moreover, what should you be doing about it?*

Shareware's biggest problem is knowing what it is and who it's for.

Shareware traces its roots to the beginnings of the hacker ethic. (Hackers are good people, not bad. They push the limits of their machines and their understanding for sheer enjoyment. The press corrupted the word *hacker* in the early eighties to describe criminals who vandalize on-line systems.) The original hackers saw computers as a tool of democratization and even revolution, in which sharing of knowledge and solutions was paramount. They spread the fruits of their labors through the Unix mail system, ARPAnet, and other public and private networks.

Today's bulletin boards and public systems are descendants of the communal approach to computing. The first inklings that programmers could get paid for their postings came in the late seventies, on the CP/M bulletin boards. Macro assembler and utilities jocks like Sam Singer put notes in the source code saying, "If you liked this program and you'd like to see more in this vein from me, send me a donation, five bucks or so." This donation/charity approach continues to affect attitudes toward shareware.

User groups were, and continue to be, a major distribution channel for shareware. Frankly, user groups didn't do much for shareware's image in the early days, since they were hotbeds of software piracy and illegal duplicating. User groups have long since cleaned up their act, but the stigma still lingers in some quarters. Shareware is tarred with the old brush, and some corporate types can't figure it out. So they dis-

miss it as illegal or immoral.

Jim Button's *PC File* was the first major PC program that used shareware as its main means of distribution. Another early starter was Andrew Fluegelman's *PC-Talk III*. *PC-Talk III* was offered as "freeware," a misnomer that heightened the already-rampant confusion over whether the software was public domain or required a license fee. Button, to his credit, has always used terms such as *registration fee*, *license*, and *purchase*.

Since shareware is distributed on the honor system, there is no way to ensure payment. More-aggressive Aquarians have put messages into their programs that threaten bad karma, ill luck, and lifelong guilt if you don't pay. Unwittingly, these authors sank to the same level as those who initiate chain letters, and with about as much effect. Rather than spurring people to pay, they alienated their audience.

One group, the Association of

Shareware Professionals, has worked hard to clear up misconceptions about shareware. They've drawn up a set of by-laws that set forth some definitions of shareware, including features and terms of payment. The ASP's membership adheres to a code of conduct and representation that gives users consistency in terminology and business practices. For example, the term *donation* is never used. ASP members characterize the fee associated with their products as a license fee, just like that of any other software package.

The ASP specifically prohibits its members from offering software that is limited in any way. ASP shareware has no missing features (such as saving files or going beyond 25 records) that get turned on when you pay your registration fee. Such *crippleware*, as it has been termed, is anathema to the association. When you get an ASP package, you get the whole thing. You are then bound by your honor to pay the fee if you like and use the package.

**SHAREWARE STRENGTH** Shareware has some key advantages for software authors and users. For authors, it amounts to guerrilla marketing. There's no cheaper way of getting your product out there. The network of cognoscenti is far-flung, with broad interests. Feedback on a program's strengths and weaknesses is instantaneous. Updates are often similarly instantaneous. Shareware authors usually have a bulletin board that serves as their base of operations. It may run on one of their home PCs, or it may be a local software exchange bulletin board. Often it's



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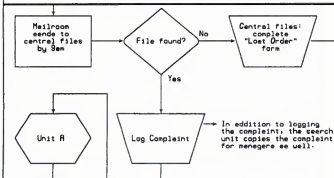
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## VIEWPOINTS

### ■ BILL MACHRONE

one of the big public services, such as CompuServe, The Source, or GENie. CompuServe's IBMNET is the largest such beast, with virtually all the major shareware packages available.

Virus scares have caused problems for shareware. Public information utilities are ostensibly potential hotbeds of viruses. The truth is that all major viruses to date were transmitted by commercial packages and private mail systems, often in universities. Public information systems, bulletin boards, and shareware authors have more to fear from these pranks than do most students. So they work extraordinarily hard at policing themselves to keep viruses out. Businesses, of course, have the most to lose. In the course of controlling potential sources of contamination, some have forbidden shareware. What they should forbid is willy-nilly downloading of games and utilities from bulletin boards where the sysops don't examine the programs that get uploaded to them.

Not all shareware is distributed on-line. Some companies work by direct mail: for a nominal fee you get the program on-disk. If you like it, send the full amount. If not, reformat the disk or pass it to someone who may want or need the program.

A number of companies remarket shareware. Outfits such as Microcom and the Public (Software) Library publish shareware for a few dollars per disk. Most are up-front about telling you that the shareware on their disks requires additional registration fees if you decide to use it. A few hide the fee in phrases such as "Most software listed is shareware or user supported." That's not much help if you don't know what it means. The real service that these outfits offer is one-stop shopping, and the convenience of not spending hours on-line looking for the right program. They also provide a valuable service for people who (incredible as it may seem) still don't have modems.

It's time to recognize that there's nothing to fear in shareware. As a distribution medium, it saves you money and helps you try out new genres of software with minimum risk. The best shareware can go toe-to-toe with the best retail software. Much of it serves as a stepping stone to better packages. And the worst stuff... well, at least it didn't cost you anything. ☐

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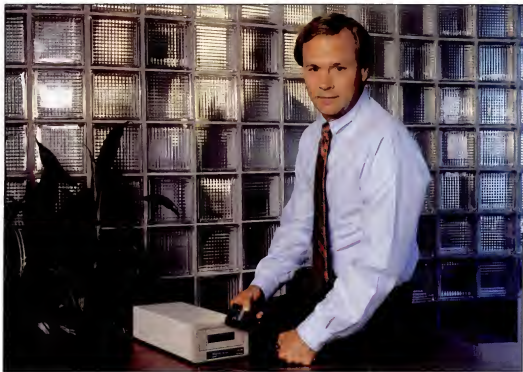
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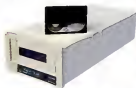
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# COLLECTING HISTORY, PART 2



*Computer curiosities, peripherals from the past, and Stone Age software aren't just junk—to some people, they're collectible works of art.*

I like to classify computers as collector's items because it gives me an excuse for keeping a lot of junk. My motto: "I can't throw this out! It's a collector's item. It will be worth a fortune someday!"

A while back, I discussed collectible computers from the 1975–1980 era in this column ("Collecting History," January 12, 1988). Most of those old dogs are hard to find. A better approach may be to spot the machines among us now that are doomed, er, I mean "destined" to become obscure collector's items.

**ODDBALL GEMS** I was reminded of this pursuit when I recently read something about a computer from a few years back. Dubiously dubbed the DOT, it was a big deal when it was released. There were gala press conferences and fancy seminars. This machine was designed to be portable and to compete with the IBM PC and the Compaq portable. The big advantage of this thing was that it had 3½-inch disk drives before they were in vogue (and consequently before there was any software on 3½-inch disks) and a built-in printer. All in all, it turned out to be a clunker.

While many of these machines are expensive when first introduced, they soon hit the skids and can be bought for peanuts (software included). I'd say that something like the DOT should be available for about \$200 now.

If you don't want to collect oddball computers, then you may want to collect peripherals. I think the mouse is a collectible. If you can get your hands on an old Microsoft mouse with the heavy all-metal

ball, grab it. It's going to be a hot item. It sounded like you were in a roller rink whenever you moved it around.

In this same vein, I picked up a classic collectible last September. During the rollout (as it were) of the newest Microsoft mouse, the company gave away a commemorative mouse ball with details of the occasion printed on it. Stuff like this is always worth keeping. One of my favorite items is the special silver dollar minted by WordPerfect a couple of years back and given to dealers. This coin has the added benefit of becoming a collectible for coin collectors, too.

**STASHING SOFTWARE** This brings us to the most obvious thing to collect: software. And I don't just mean the code in the form of a bootleg copy, although for demonstration purposes you may only be able to get bootlegs of old games. What I mean by collectible is the original disk in

the original package. A copy of *CP/M WordStar* in the large padded 8½-by-11-inch binder with the pink ink on a white background is what I'm talking about. Any of those old programs sold in big binders (pre-IBM boxes) should be kept. If you find a friend with some old copy of *dBASE II* in the big silver binder, offer him \$5 for it. Tell him that you collect binders. Trust me—someday it will be worth thousands.

Also look for the oddball package. I think the initial release of *Symphony* in the weird plastic box is a perfect example. Or a copy of the *Smart Software System* in the clear Lucite box. Any of the old Microsoft packages in the hard plastic case should be kept. I recently stumbled on an old Microsoft Z-80 card for the Apple II that I now have on display—keep an eye out for those.

When you go through your boxes of junk, think in terms of art and collectibility. While I think that big-flop software is more interesting, and thus more collectible, I suspect that Release 1.0 of any major software package such as *WordPerfect* will be cherished too.

I assume that once you begin to think in terms of collectibility, you'll find many weird software packages and peripherals at computer stores and see them for what they are: collectible junk. The drawback is that the stuff is too expensive to buy new. So go to the computer swap meets, and you'll find bins and barrels filled with goodies. Let me tell you before some other columnist tells you: It's not a barrel of junk. It's a gold mine.



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■ JOHN C. DVORAK

# INSIDE TRACK

*Is the 80386 microprocessor cloned by Mitsui a threat to Intel's Grand Scheme?*

Just as Intel is rolling out its 386SX chip to crowds of admirers, a new Japanese consortium is about to **blow out** a hotter-than-hot 386 clone chip and rain on Intel's parade.

Apparently, the giant conglomerate Mitsui joined forces with the brain trust at ASCII Inc. to form an entity called VM Technologies. Mitsui is committed to **dropping a billion dollars** into a new fabrication facility dedicated to the manufacture of microprocessors. The first chip is the VM8600S, a CMOS chip that will run 80386 instructions, 80286 instructions, and 8086 instructions and come out of the chute at 20 MHz for a price well below that which Intel is charging for its 386 or 386SX.

What engineers are abuzz about is a special mode of the chip called the VMZ mode. In this mode the chip runs an optimized 8086 instruction set that supposedly scoots along **50 percent faster** than you would anticipate if you just checked the clock speed. In other words, it's a screamer.

It's possible this chip will find its way to our shores in the months ahead, although the consortium is concentrating its marketing in Asia at present. It wants to take *all* the market share away from Intel overseas before it comes here.

This may spell **trouble for Intel** if this new company can do what it plans to do. The irony is that this situation developed only because Intel refused to second-source the 386 chip in order to maintain a high price. **So hello clone!** If Intel had licensed the chip and the market was competitive, nobody could have afforded this stunt.

Worse, if the 8600S is sold cheaply enough, the entire Intel 386SX marketing strategy will go **down the tubes**.

Computers built with the 386SX will become instant **monuments to marketing folly**—collector's items, as it were (see previous page). Most design engineers aren't convinced that the 386SX solution is as cost-effective as Intel would like us to believe. "A little VLSI around a regular 386 chip will bring the system price down close to that of any 386SX machine," says one critic. Furthermore, Intel has hinted that the 386SX will not be manufactured to operate any faster than at 16 MHz. This **makes no sense** because the SX is basically the same chip as the 386 except that a few features were removed and its data path reduced.

More and more the 386SX is starting to look like one of those **old marketing schemes** in which someone has a powerful product and decides to disable a few features so that he can rationalize selling it at a lower price. The software industry has been **plagued with this chicanery** for decades. It's like going into a pet store, looking at a pedigree dog, and balking at the price. The store owner says he can sell you the same dog at half price, but he has to shoot the poor mutt in the foot first. **Who are they kidding** with this nonsense?

**IBM and the Great Rebate of 1988 Dept.:** Apparently nobody is standing in line to deliver his perfectly good PC ATs to IBM for a \$750 trade-in price in exchange for a hot (yawn) new PS/2 machine. What's the point of this trade-in deal? Is IBM encouraging the dealers to become used-car, er, I mean used-computer dealers? Apparently not. Reports indicate that the machines are not being recycled by IBM, but destroyed. I mean, the company could at least give them to poor school districts in the rural South. Too much trouble, I guess.

The funny thing about the IBM rebate is that a few dealers who take in the old machines are recycling them. Knowing a good thing when they see it, they polish the old clunkers and sell them for \$1,000 or more. Not a bad price for an AT with the IBM logo!

**Genuinely Interesting Software Dept.:** Over the past few months there has been a hullabaloo over the importance of **shareware** in this marketplace. One writer **condemned** it, saying that people should commercialize or get out of town. He's doing software on the side and, I suppose, hates these **guerrilla marketers'** taking away business with cheap software that is often high quality. I was trying to find a good scheduling/reminder/calendar-type program when I ran into one of these gems. It's called **Tickler** (Integra Computing, P.O. Box 72063, Marietta, GA 30007; (404) 973-3586), and it sells for \$50. Part of an elaborate billing and bookkeeping system called **Managex** (\$200), this assembly-language-coded system is **surprisingly fun to use**. I actually put this system to work! Mr. Organization.

Anyway, the facts are in and **budget-minded** computer users can do worse than use shareware systems to round out their library. If we view shareware as a method for **bootstrapping** a small company into existence, then I don't see how anyone can complain. Many users complain that the magazines don't write about shareware because these companies don't advertise. I know for a fact that this does happen in other publications. It doesn't happen here, though. (Besides, the best vendors eventually become advertisers anyway. Why be myopic? My problem is discovering the best stuff.

Anyway, the shareware types have helped keep prices low, and they **encourage newcomers** to enter a hectic marketplace that nobody in their right mind would get into. Oops. Did I say that?







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## Lotus Symphony 2.0

■ JIM SEYMOUR

# A PC PRIORITY CHECKLIST



*What most influences your decision to buy a PC? Is it its performance or reliability record, or maybe even its price tag? Compare your ideas with those of a top PC designer.*

A couple of issues back, I recounted part of a very interesting talk I had with Chet Heath, the principal designer of IBM's Micro Channel architecture, found in the PS/2 line.

I wrote then about Chet's emphasis on the importance of the improved reliability of PS/2s. IBM's own internal (unpublished) figures indicate that field experience with PS/2s over the past year and a half has shown them to be two to three times more reliable than PC ATs. That increased reliability translates directly into cost savings, Chet pointed out—especially for those who purchase service contracts, which are far cheaper on PS/2s than on PC ATs and PC-XTs.

Arguing about the economies of owning a PS/2 got us into a discussion of our respective priorities in judging PCs. At first, Chet's list seemed somewhat different from my own—and probably from yours as well. He put performance in seventh place, for example, while I had it in third. His ideas were so provocative that I thought you'd enjoy hearing them here.

**THE BIG EIGHT** In declining order, from most important to least, Chet's eight-item list of priorities looks like this: personal safety, data integrity, system integrity, reliability, compatibility, functionality, performance, and cost.

"Personal safety" threw me for a loop, especially as the first item on his list. But on reflection, I think he's exactly right: remember, this is a PC designer for the Largest Computer Company in the World speaking.

By personal safety, Chet means simple but important things, such as no sharp edges on metal, no parts that get dangerously hot to the touch in normal operation, and so on.

Second, Chet lists data integrity, or data safety. Chet's definition of data integrity is: "Even if the whole system fails, the data is safe. You may lose the computer, but you don't lose the data."

Fair enough: I'll always prefer to lose a PC over my data in a catastrophic failure, but keep reading.

Third on Chet's list is system integrity. "I mean, for example, that you can't do anything from the keyboard that brings the system down," he says. "And it goes beyond that. I define the 'system' as including anything you're connected to, too, so let's say as well that in a mainframe connectivity environment, where you're downloading datasets, then uploading them back to the mainframe computer,

you ought to be able to prevent—or at least detect—any errors."

Reliability comes fourth. (Actually, notice that Chet's first four items really constitute what many of us would collectively identify as "reliability.") He's using the term in the traditional engineering sense, measured in MTBF (Mean Time Between Failures).

As I said, IBM figures show PS/2s to be two to three times more reliable than their predecessors, and my experience generally confirms that.

While I've seen some clusters of D.O.A. problems with PS/2s, and other cases where inordinate numbers suffered from problems right out of the box, in general the Model 50s, 60s, and 80s have proven very reliable indeed.

Fifth on Chet's list is compatibility. Chet acknowledges that on the physical compatibility level, IBM broke the rules with the move from 5¼-inch to 3½-inch floppy disks, and from the AT bus to his new MCA bus design. "But on the logical compatibility level, we did very well," he says. "You can run the same programs and datasets you've been using on ATs on the PS/2s."

In sixth place is one of Chet's curve balls: functionality. I was struck not so much by the term, but by his definition: "Don't introduce anything which, no matter how useful it seems, compromises any of the previous five priorities."

"For example," Chet says, "if we were to introduce something like a radio-frequency wireless local area network system into our planar boards—and don't worry,



## ■ JIM SEYMOUR

we won't—that could compromise everything else we've done on reliability and integrity and safety. We'll never do that."

We finally get to *performance* in seventh and next-to-last place on Chet's list.

He's unhappy about a lot of what he's seen in testing PS/2s against other PCs. "The problem is that single-thread PCs have to be benchmarked against single-thread benchmarks. When you have a multiple-

thread machine, where that capability was an important part of the design, in fairness you have to measure it against multiple-thread benchmarks.

"The problem with most performance tests I've seen on PS/2s is that they ignore that multiple-thread capability of the computer and treat it as if we were optimizing the design for single-thread performance. The Micro Channel design is all about efficient multiple-thread operation, and I've seen very few tests in print that acknowledge and measure that performance."

Of course, I argued, with few multiple-thread (read "OS/2") applications programs around, and fewer multiple-thread benchmark tests, that kind of testing is both difficult and for most buyers irrelevant. But good performance when executing multiple-thread operations seems like-

■ IBM and its customers are hoping that multiple-thread capability (like most of the rest of the PS/2's design) will become a big issue sooner rather than later.

ly to become important fairly soon. IBM and its customers are both betting on what is to come: they're hoping that multiple-thread capability (like much of the rest of the PS/2's design) will become a big issue sooner rather than later.

In last place—and this won't surprise you—is cost.

While Chet is pleased that production efficiencies (growing directly out of a design-to-build engineering approach) make PS/2s less expensive than their IBM predecessors, cost comes in last after safety, integrity, reliability, and performance.

Which is as it should be.

My list? In declining order, reliability, compatibility, performance, and cost. In the end, it's nearly identical to Chet's. ☐

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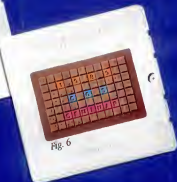
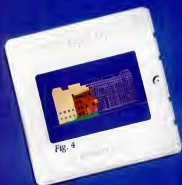
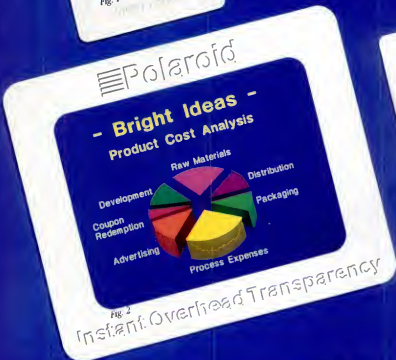
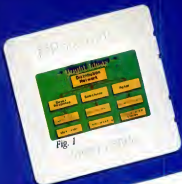
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■ STEPHEN MANES

# NEW VERSIONS, OLD PAINS



*Every software upgrade is a painful experience. It's no surprise that many users decide to stick with the familiar unless they desperately need the new.*

I'm a *SideKick* user from way back. I'm sitting here staring at the *SideKick Plus* box and thinking about switching. There's no doubt in my mind that the fresh-faced kid will do a lot more than my gray-bearded old pal. I've already transferred the files to my hard disk.

But . . . Borland's early releases have a long, inglorious tradition of significant bugs. It took till something like Version 1.5 (months after the initial release) until the original *SideKick* was truly stable, and this new program has far more potential for trouble. Still, I've fooled around with it. I mostly like it.

But . . . I've flipped through the manual, and I can see heavy study ahead. My fooling around has told me that getting used to the new program will take a while. Do I want to put in the time it will take to learn it? Or should I bite the bullet and change my AUTOEXEC.BAT?

But . . . just setting the thing up properly will be a chore. There are eight million different ways to configure it to use system memory, and infinitely more to fine-tune the screen displays. I can't stand the defaults. So maybe if I find a spare day or two somewhere down the line . . .

**IT'S SPINACH** I've got a review copy of the program; I didn't even have to pay for it. And I still can't make up my mind. No wonder so many users I talk with often decide that updating software is just more trouble than it's worth.

I may have the chronology a little out of whack, but this attitude seems to have taken hold around the time *Lotus 1-2-3*, Re-

lease 2.0, began shipping. Despite its fancy new memory model and extra features, lots of users decided that it was spinach and said the hell with it, especially since the upgrade wasn't cheap and it required you to return the original disks. The old version remained the industry standard until enough new users joined the 2.0th century. To this day, so many untranslated old-format .WKS spreadsheets exist that dozens of other programs accept them, as well as the newer .WK1 format. And plenty of users have still never bothered to upgrade from the 2.0 version to the slightly improved 2.01 edition.

The same thing happened with the successive just-barely-better DOS versions that arrived with each new disk format. Users who desperately needed one or another added feature went with the new editions (mostly via the low-cost DOS COPY command; DOS in all its flavors, is undoubtedly the most pirated program in

history). Others stuck with whatever they began with and never knew the difference. A huge percentage of hard disks still boot with the DOS version that came in the box (or, in the case of clones, from the dealer or the pal with a PC). After all, installing a new version of DOS on a hard drive is something about which the DOS manuals have been silent; a sizable number of DOS users don't have manuals anyway.

**YEAR OF THE UPGRADE** This seems to be the year of the software upgrade. Every time I turn around a new version of some venerable product arrives at my door, promising dozens of marvelous new capabilities and features. But many users I know are beginning to shrug their shoulders. "There are already a hundred features in the program I never use," they point out. "Why should I bother worrying about 50 more?"

I sympathize. Boy, do I sympathize. It's part of my job to look at new products, and lately I've seriously begun contemplating the easy way out (which, until now, I've tried to avoid): let some honcho from the company walk in with a portable machine that has the program already loaded and running, so that I don't have to go through the pain of installing the damned thing. Every time I look at a gargantuan software box with a half a dozen disks and a manual suited to power lifters, I shudder at the thought of another morning, afternoon, or lifetime frittered away.

You have to act defensively; you never know when somebody's installation program is going to clobber your CON-



■ **STEPHEN MANES**

FIG.SYS or AUTOEXEC.BAT file. Then there's the initial test period, the trial run when you figure out how to use the program and see if it's going to make hash of your usual methods—or, worse, your

files. If you use TSR programs, you may have to fiddle around with loading order. And if you're an early switcher, you've got to keep your eyes glued to the press for the announcements of the inevitable bugs and

for the fixes that rarely get delivered to users who don't ask. If, however, you decide to wait until things are smoothed out, chances are you'll have waited until the next upgrade, when the whole process begins again.

Upgrade policies have softened since the early days. Prices have come down to a reasonable level. But the software costs are the tip of a mammoth iceberg whose submerged nine-tenths are labeled "re-training." Frustrated managers tell me the costs of training and support hardly ever get factored into proposals for upgraded hardware and software. But even though most manuals include a section for long-time users, retraining and support invariably remain the greatest expenses.

**YES, YOU WILL** You can sniff at much of the "neat" new stuff added in the endless features war—chances are you will live to a ripe old age without ever experiencing the joy of sticking a tiny pie chart in the upper-left-hand corner of a bar graph in

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 0018 our current system will not cut the master. We may possibly need to move on  
 0019 0014 0013. CONSIDER INSTEAD: It is clear that 0020  
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 0023 while currently speaking. In event, it would be advantageous to use if a new  
 0024 0023 0013. CONSIDER INSTEAD: It is clear that 0025  
 0026 0023. REPLACE advantageously by a secure hospital 0027  
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landscape mode—but eventually you will upgrade, like it or not. Hardware improves: the advent of the laser printer instantly made most old-model word processors obsolete. Operating systems improve: subdirectories sent programs down new paths. Applications have to keep pace.

But the switchover is never painless, and it can be agonizing. Can't you just see some boneheaded network administrator changing program versions in the middle of your most important project? Can't you hear that smug voice saying, "We can't have everybody using a different version, now, can we?" Don't you suspect that that administrator might not live to see the next upgrade?

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TAKE IT OR LEAVE IT

# PORTABLES WITH DESKTOP POWER



The best portable PCs still fall short of the abilities of the best desktop PCs. But the difference is now a gap, not a gulf, and that means you'll find that a portable PC could be the only PC you'll ever need.

The ideal desktop-replacing portable has a 15- to 20-pound weight, an 80286- or 80386-based processor, room for several megabytes of memory, at least 30MB of hard disk storage, an illuminated screen with EGA- or VGA-level monochrome resolution (color would be nice, but the

technology doesn't exist yet), a keyboard with separate numeric keypad area or the ability to plug in a full-size keyboard or numeric keypad, and room for one or two PC or AT bus expansion slots that could be filled with a network adapter card, a PC-to-mainframe (IRMA) card, a fax board, or a color video card. For a significant fraction of users, battery power is crucial.

Except for the battery, the description of the perfect portable isn't dissimilar from that of the perfect desktop PC. And no wonder—you shouldn't give up power just because there's a handle on the system unit.

**FOUR CLASSES** Portable PCs fall into four rough categories. Think of four quadrants based on combinations of "less (or more) filling" and "tastes great"—or portability and power, respectively:

■ Lightweight battery-operated laptops with limited processing power (limited compared with what you find on the desktop), ranging from non-DOS Tandy lap-

tops to 8088/8086-based NEC, Toshiba, and Zenith machines with 10MB and 20MB hard disks. Most of the excitement in the DOS-to-travel market in 1986 and 1987 took place here (for example, with the now-defunct Zenith Z-171, which the IRS bought by the carload in early 1986), but these machines lack the power to run 1988's applications at a serious pace, to say nothing of future OS/2 applications. This is the quadrant where size plays the biggest role in buying decisions, and the only category in which a nonilluminated screen *might* make sense—but only on the least expensive machines. The most interesting laptop machine in this category is the Toshiba T1000 (6 pounds, one drive, \$1,199). Buy one as a traveling adjunct to your desktop PC, never as a replacement. *Taster's summary: Less filling, tastes weak.*

■ AC-only sewing-machine and lunch-box-size units with 8088/8086 processors, 5¼-inch floppy disk drives, and 9-inch CRTs or first-generation backlit LCD screens, such as the original Compaq Portable. Only Sharp continues to display much interest in this category. It's unlikely you'll see any more introductions in this near-beer category, because it's only marginally more expensive to build in a CPU for grown-ups. *Too filling for such weak taste.*

■ The 80286- and a handful of 80386-based clamshell- and lunchbox-style portables with limited battery power (less than 2 hours), illuminated LCD screens, 3½-inch floppy disk drives, and, usually, hard disks. A few make provisions for 8- or 16-bit expansion cards through small expansion boxes. *Less filling, tastes great.*

■ AC-powered 286 and now 386 portables, with either 5¼- or 3½-inch floppy disk drives, almost invariably with fast (under 40-millisecond average access time) hard disks, and all with illuminated screens (LCD, electroluminescent, or gas plasma). Some units are wide enough for a separate numeric keypad on the keyboard. Many have room for expansion cards in-

ternally or in clip-on bustles. You'll find a mix among clamshell laptops for strong laps, lunchboxes, and sewing-machine configurations; the latter two designs typically have detachable keyboards. Compaq was the pioneer in this field, but it's getting to be a crowded field. *More filling, tastes great.*

This article reviews 12 80286- and 80386-based portables from the latter two categories. You'll find at least one with enough features to rate as both your desktop and your portable PC. All 12 have 80286 or 80386 processors and hard disks, and all accommodate at least one 8- or 16-bit expansion card internally or in an expansion unit.

If you're really serious, you'll consider only 80386-based PCs, including portables. While both 286 and 386 systems can run OS/2, only a 386 provides a future with no limitations. The Intel 80286 chip represents too many compromises. Already, some important programs have 386-specific versions (*Paradox*, *Q&A*) that won't work on 286 PCs. (You still can buy general versions of these programs that run under any chip that runs under MS-DOS.) And there's a real chance that the operating system that succeeds DOS won't be OS/2, but OS/2-386 or OS/2 2.0 (two likely names for Microsoft's 1989-1990 386-only second round of OS/2). In the interim, you can get real utility from 386-only DOS-extending multitasking programs: *Microsoft Windows/386*, *DESQview*, *Concurrent DOS 386*, *PC MOS/386* (see "The Taskmasters: Real 386 Operating Environments," *PC Magazine*, November 24, 1987). They let you load and run several DOS applications at the same time.

One other drawback to the 286: few 80286 chips are available in low-power CMOS (complementary metal-oxide semiconductor) versions, while the 386 is CMOS by design. Non-CMOS chips would overwhelm battery-powered machines. No portables based on the new Intel 12-MHz 80386SX processor are avail-



.....  
*Searching for a portable computer that can double as a desktop PC? The perfect desktop-replacing luggable may not yet exist, but these 12 286 and 386 contenders make full-function portability a reality.*  
 .....

## ■ 286- AND 386-BASED PORTABLES

able yet, but they will be shortly. The 386SX is a CMOS design.

**EXPENSIVE—AND WORTH IT** The machines reviewed here represent serious investments. With the exception of the Datavworld Portacomp II, they cost \$4,000 to \$8,000 list price with 1MB RAM and a hard disk. The newer and quicker Compaq, Zenith, and Toshiba 80286 portables are \$5,500 to \$6,000 list with 40MB drives; in comparison, a desktop 12-MHz Compaq Deskpro 286 system unit with 40-MB drive is \$4,200, plus \$425 list for a monochrome display and adapter. Most of the 80386 portables are \$7,500 to \$8,000 with 40MB drives; desktop 16- and 20-

(\$300 to \$600) for your desktop, a separate EGA or VGA video card if your portable can't output better than CGA (\$200 to \$500), and an expansion bustle or box (\$200 to \$500) if it isn't included.

When you're all done, you'll pay an extra 25 to 50 percent for the freedom of portable computing. Too high? Don't forget that the real cost of a PC also includes software, training, maintenance, and support. Over the 3 to 5 years of a PC's life, the hardware represents a minority share of the complete cost.

### IMPROVED SCREEN TECHNOLOGY

In addition to processor type and unit configuration (clamshell, lunchbox, sewing machine), you have a choice of display types. The Compaq Portable II has a traditional, 9-inch-diagonal cathode-ray tube—the best screen in the biggest and bulkiest system unit. It's the only display that competently converts colors to gray scales. (Most others reviewed include a utility to remap colors as limited shades of black and white.) Oddly, Compaq never opted to install a 9-inch EGA or VGA color CRT in its now-aging unit. If there ever was a time to build in color, it's probably past. Most users who want color when they're traveling borrow a color monitor at their destination.

The other 11 portables use one of three types of flat-panel displays:

- Liquid crystal displays (LCD) and supertwist LCDs with separate backlit illuminating panels. LCDs provide anywhere from 3:1 (standard LCD, no backlighting) to 12:1 (supertwist, backlit) contrast ratios. Power consumption is minimal, about 1/5 watt without illumination, 7 to 10 watts with. LCDs are also the cheapest flat-panel technology to produce. They're slow to update; fast-moving graphics and scrolling create temporary screen blur. Only recently have LCD screens advanced beyond CGA-level 640 by 200 resolution to EGA-level 640 by 350, with VGA-level 640 by 480 in the offing. To achieve the resolution, you need both a video controller and a screen capable of that output.

- Gas plasma, the glowing red-and-orange displays on Compaq and Toshiba portables. Like LCDs, they have limited ability to translate color to more than a handful of gray shades. They provide ade-



## The Price-Portability-Performance Triad

**P**ortable PCs fell into four categories based on power and portability: battery-powered versus AC-only and 8088/8086 versus 80286/80386. The bulky, heavy Compaq Portable and the IBM Portable PC were the first transportable PCs (lower-left quadrant); this is an all-but-defunct category. Battery-powered 8088/8086 portables (upper-left quadrant) were the first serious DOS-to-travel machines. Look for the biggest growth in the next year in battery-powered 80286/80386 portables (upper-right quadrant). Most of the dozen machines in this review are in the AC-only, 80286/80386 category (lower-right quadrant): powerful, as long as you're near an electrical outlet.

The most exciting possibility for a truly go-anywhere machine is a no-disk-drive, 80286-based laptop with several megabytes of memory. It could weigh under 5 pounds and would have a desktop docking station with a hard disk and expansion slots. Look for at least one such portable in the next 6 months.

Within each quadrant, machines are ranked according to weight and power. The size of the bubble is a relative indication of cost.—Bill Howard

.....

*Without all the extras,  
prices of the DOS-  
to-travel machines  
aren't wildly out of line  
with comparably  
powered, name-brand  
desktop units.*

.....

MHz Compaq Deskpro 386s are about \$6,500 and \$7,500 with 40- and 60MB drives.

Thus, prices of the DOS-to-travel machines aren't wildly out of line with comparably powered, name-brand desktop units. On the other hand, you can find at least two dozen hard disk/80286-based systems for \$2,000 or less (see "The Cheapest ATs Ever," *PC Magazine*, February 16, 1988), and 80386-based 16-MHz systems are fast becoming a commodity item with system prices (40MB hard disk, monitor, and video card) of around \$4,000.

If you do plan to use your portable as a desktop machine, you may need or want to add a separate keyboard (\$100 to \$150) or numeric keypad for those machines that allow it, an EGA or VGA color monitor

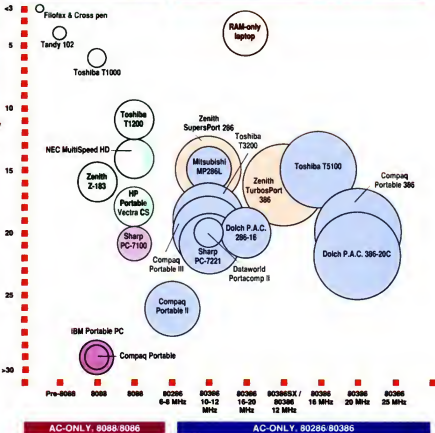


PORTABILITY

Portability is mainly low weight and small size. Also: battery power and life, ruggedness.

BATTERY POWER, 8088/8086

BATTERY POWER, 80286/80386



POWER

Power is mainly processor type and speed. Also: amount of RAM, bus bandwidth (8-, 16-, 32-bit), wait states, disk size and speed, video type and speed, and number of expansion slots (if any).

## ■ 286- AND 386-BASED PORTABLES

quate contrast and (typically) 640 by 400 resolution, commonly called double-scan CGA (each of the 200 CGA lines is scanned twice). Power consumption is high (25 to 35 watts), and the displays become quite warm to the touch.

■ Electroluminescent displays, a promising newcomer held back until recently by high costs (up to \$1,000 a panel, but now half that in volume). EL displays draw about 12 to 15 watts and provide up to 20:1 contrast. The screens are yellow on gray,

*Perhaps the most common use for a portable's expansion slot is to add a VGA or EGA card for demos.*

some with a switch to reverse the colors to gray on yellow. Among machines tested here, they're optional on the two Dolch portables.

**REVIEW CRITERIA** To be reviewed, the machines had to meet five criteria: portability; current availability; 80286, 80386SX, or 80386 processor; hard disk built in or available; and the ability to accept industry-standard 8- or 16-bit expansion cards internally, in a clip-on busle, or in a compact expansion unit capable of being readily transported.

We included the expansion slot requirement because many users want to set up a mininetwork on the road, such as a half-dozen accountants running a field audit. They need the slot for a network card. Others want to hook into a mainframe using a network card. Perhaps the most common use for the expansion slot is to add a VGA or EGA card and use the machine as a portable demo unit, hooked up to a color monitor. Most portables can directly drive a color monitor at CGA resolution, but CGA isn't good enough for serious users and hasn't been since August 1984, when IBM unveiled EGA.

**OTHER CHOICES** If your expansion needs are specific (you know what you'll be putting in the slot), you might also consider the GRiDCase 1530, an Editor's Choice in "Planes, Trains, and Automobiles: 12 Portables for the Road" (*PC Magazine*, March 29, 1988). The GRiDCase has a proprietary internal slot that can be filled with GRiD-designed VGA, 3270-emulator, or Ethernet LAN cartridges. It also has eight ROM sockets intended for custom software used by salesmen or field reps. It's \$4,695 with a 12.5-MHz 80386 processor, two floppy disk drives, plasma display, and battery power. You can also add an optimistically priced (\$999) five-slot expansion box that's suitable mostly for use as a nontraveling docking unit.

Another contender, NEC, wasn't represented because it was upgrading its \$3,995 APC IV, a 10-MHz 80286 AC-only 20MB portable with two full-length 16-bit slots built in.

The 12 reviews are arranged in alphabetical order by company name.

—Bill Howard

*Bill Howard is an executive editor of PC Magazine.*

### COMPAQ COMPUTER CORP.

#### Compaq Portable II

Old friends can be the best friends, but reunions are often disappointing. The Compaq Portable II Model 4 was hot news a few years ago, but today it's neither technologically exciting nor price-competitive. The Portable II's sewing-machine design and 26-pound weight make it the largest and heaviest machine reviewed in this roundup.

The Portable II is a \$4,443 8-MHz 80286-based computer with 640K RAM, a single 360K 5¼-inch floppy drive, and a 20MB 85-millisecond hard drive. The tested unit also included an 80287 math coprocessor. This machine is approximately the same weight but with smaller dimensions than the original Compaq, the 8088-based Compaq Portable.

To set up the Portable II you merely place the machine on its side, put up the lower-body support, snap two locking devices to release the keyboard, remove and

plug in the power cords, plug it into a power source, and flip on the switch.

When the system boots up, one of the Portable II's strongest features becomes apparent: the screen is terrific. Compaq's dual-mode green screen displays text in 720 by 350 resolution and is much more comfortable to look at than LCD, electroluminescent, or gas plasma screens. In graphics mode the screen switches to CGA-compatible 640 by 200 resolution. This display uses a conventional cathode-ray tube (CRT) and is a major reason for the computer's relatively large size and weight. The Portable II is the only machine reviewed here to use CRT technology. Graphics are not displayed with a true aspect ratio.

The keyboard doesn't add much to the unit. It has 84 full-sized keys with 10 function keys, a numeric/cursor-control keypad, and LED indicators for CapsLock, NumLock, and ScrollLock. The keyboard is not very responsive, however, offering little tactile feedback while being very sensitive to even a light touch. In the beginning it's especially easy to find yourself typing unwanted characters when your fingers are merely resting.

The unit has four expansion slots, two 8-bit and two 16-bit. Two are used by the video card and by the floppy-and-hard-disk controller, so only two others are actually available for options. The Model 4's



### FACT FILE

#### Compaq Portable II

Compaq Computer Corp.

20555 FM 149

Houston, TX 77070

(713) 370-0670

List Price: Model 2 with 256K RAM, two

5¼-inch 360K floppy disk drives, \$2,699.

Model 4 with 640K RAM, one 5¼-inch

360K floppy disk drive, 20MB hard disk,

\$3,999; MS-DOS 3.2, \$95; carrying cases:

nylon, \$89; leather, \$225

In Short: The Compaq Portable II is a proven

8-MHz 286 portable computer, but its

heavier weight and relatively slow speed re-

flect the older design of this unit. It's a fine

machine but is no longer either price- or fea-

tures-competitive with newer computers

from Compaq and others.

CIRCLE 666 ON READER SERVICE CARD



◀ The Compaq Portable II, weighing in at a hefty 26 pounds, is the ancestor of the lighter Compaq portables reviewed in this issue. The machine's high-resolution green-on-black CRT screen is a major contributor to its extra weight.



▲ The Compaq Portable II has four expansion slots, two of which are available for options. You can bring the total memory to 2.1MB without using an expansion slot, and memory ghouls can sacrifice a slot to upgrade the memory capacity to 4.1MB.

standard 640K memory can be expanded to a total of 2.1MB without taking up an expansion slot by using an optional 1.5MB system memory board that plugs into the bottom of the motherboard. Once that board is in place, another optional memory board that does use a slot can hold up to 2MB, bringing the total possible memory configuration to 4.1MB.

The Portable II's 8-MHz system clock was fast when this machine was introduced, but now it's the slowest of the machines tested in this review. In all memory tests the Portable II is just as fast as an 8-MHz IBM PC AT. The 85-ms, 20MB hard drive is also slow, lagging behind the 39- to 28-ms. drives usually installed in AT-compatible machines. The 360K floppy drive, long the standard of the PC and XT world, is certainly usable, but its low

.....  
*The Compaq Portable II's documentation is noteworthy because it is both so extensive and so well done.*  
 .....

capacity is an inconvenience when comparable machines use 1.2MB floppies or even 720K or 1.44MB 3½-inch floppies.

Standard interface ports on the Portable II include a parallel port, serial port, and plugs for external RGB or composite monitors.

The Compaq's documentation is noteworthy because it is both so extensive and so well done. Ample use of illustrations and clear explanations, combined with helpful divider tabs and indexes, make the manuals very helpful for those users who ever look at them. In reality, many owners may never know how good the Compaq documentation is and assume that it's typically abstruse and poorly written—neither is the case.

The Compaq Portable II is basically a dated machine. Its appealing screen helps it to qualify for both desktop and on-the-go status, but its large size, heavy weight, relatively slow performance, and noncompetitive price suggest that it is a machine to pass by. You sure wouldn't want to carry this baby through too many airports.

—Bruce Brown

## ■ 286- AND 386-BASED PORTABLES

### COMPAQ COMPUTER CORP. **Compaq Portable III**

Put away the sewing machine and take out your lunchbox. Compaq's Portable III is a clear winner over the company's other 286 design model, the Portable II. The newer Portable III is smaller, lighter, and half again as fast. Naturally the advantages come at a higher price, but the only major

drawback to this machine is that it has no internal standard expansion slots.

The Portable III is a 12-MHz 80286-based computer with standard 640K RAM and a 1.2MB floppy disk drive. There is a lower-priced Portable III called the Model 20, which has a 20MB hard drive, but the tested unit, designated the Model 40, comes with a speedy 40MB drive—more appropriate for today's computing, both in

the office and on the go. The tested unit also came with an extra 512K RAM, an 8-MHz 80287 coprocessor, and an internal 1,200-bit-per-second modem.

The Model 20 lists for \$4,999 and the standard-configuration Model 40 costs \$5,799. The test unit totaled \$6,518. Not included in that price is a fantastic leather case that costs \$225—expensive for a bag, but less than 5 percent of the total system



◀ The Compaq Portable III is the souped-up, stripped-down version of Compaq's other 286 model, the Compaq Portable II. Lighter and faster than its predecessor, the Compaq Portable III gives you a 40MB hard drive, gas plasma screen, and IBM Enhanced-style keyboard for \$5,799. The Compaq Portable III with a 20MB hard drive retails for \$800 less.



▲ The Compaq Portable III has no internal expansion slots. An extra \$199 will buy you a piggyback expansion unit that holds two full-length boards.

**Which of these  
programs  
is the #2 PC database  
in the world?**

- ☐ **Oracle®**
- ☐ **Paradox®**
- ☐ **DataEase®**
- ☐ **PC/Focus®**
- ☐ **R:base®**

## ■ 286- AND 386-BASED PORTABLES

cost, and the carrying comfort, not to mention the added élan compared with the \$89 nylon case, makes it an easily justifiable add-on purchase. After all, you need a case, right? You might as well get the more comfortable one so that you'll carry the machine around more often and, theoretically, be more productive. MS-DOS 3.3 costs an additional \$120.

How heavy is 20 pounds? From office to car to house, it's not too much. When you're walking 12 Manhattan blocks with the temperature at 96 and the humidity not far behind, 20 pounds becomes a good workout, even with a good case. After 10 or 15 minutes you start thinking about balanced loads and how soon you can switch to your other aching shoulder. Anyone used to lugging around earlier Compaq models will find the Portable III easy to carry. Laptop owners who "move up" will not be terribly happy with the extra weight.

The gas plasma display screen is a pleasure to use. After you open the unit by taking the keyboard off the front, you unlock the screen and let it swing forward, up, and back. You can use the computer with the screen in its locked 90-degree position, but it's more comfortable tilted back to about 105 degrees. The light-orange-or-dark-orange screen has just one control, for brightness. This screen is not as nice to work with as the earlier Compaq dual-mode screens, but it's pretty good—much

better than most LCD screens—and its lighter weight and smaller size are key factors in the Portable III's improved size. Users with graphics in mind should note that the off-spec aspect ratio results in flattened circles.

**TAKE IT HOME** After using this unit and the faster 386/20 unit with the same case and screen, I've rethought the role of luggable computers. This unit is comfortable enough to use for hours on end at the office and light and easy enough to pack up and take home every night. With this or the 386/20 unit on your desk, you'll regain some of the space taken up by larger XT- or AT-sized units and still have enough speed and storage space for most applications. As a laptop user, I'm used to considering portables as "extra" computers, but these machines could qualify as "only" computers in my book.

The keyboard is permanently attached to the computer with a coiled cord that lets you work about a yard away from the screen. An extra foot or so would be an improvement. The keyboard on the Portable III (different in this case from the 386/20) is very similar to the original IBM PC AT keyboard, except that the ten function keys are arranged horizontally across the top of the keyboard. The keyboard's feel is a slight improvement over those on previous Compaqs; the keys feel less mushy and more responsive.

By using a special memory interface board, which takes sets of either 256K or 1MB chips, you can increase the system's RAM to 6.6MB total. The unit performs about 1½ times as fast as an 8-MHz IBM PC AT, consistent with its 12-MHz rating.

The 40MB hard disk drive is rated by Compaq at less than 30 milliseconds average access time, also consistent with our findings. External ports on the Portable III include a parallel port, a serial port, and an RGB external monitor port.

The manuals that come with the Portable III are typical Compaq—read "very good." They include lots of illustrations and charts, as well as functional topics logically separated by divider tabs.

Unfortunately, you cannot add third-party expansion boards to this machine internally. You can purchase an Expansion Unit for \$199 that fits on the back of the

unit and holds two interface cards, but to work around the liability this way somewhat defeats the machine's portable design. If, however, you want to use the Portable III on a network in the office, the Expansion Unit lets you hook up while you're in the office and then work on your own elsewhere.

The Portable III Model 40 is a solid performer that can be equally functional at the office, at home, and on the road. There are no internal expansion slots, but Compaq will be happy to sell you all the extras you'll ever need, including an external expansion unit. Like all Compaqs, this unit seems a bit pricey, but steep discounts from dealers may put Compaq quality within your grasp. —Bruce Brown

### COMPAQ COMPUTER CORP.

#### Compaq Portable 386

Yesterday's screamer still makes a lot of noise. When the 20-MHz version of the Compaq Portable 386 appeared, it was one of the two fastest computers in the PC market; the other was Compaq's desktop version. Today the Compaq Portable remains among the fastest luggables around, and it's still a top choice if you're looking for this much power and expandability in a portable computer.



#### FACT FILE

**Compaq Portable III**  
Compaq Computer Corp.  
20555 FM 149  
Houston, TX 77070  
(713) 370-0670

**List Price:** Model 20 with 640K RAM, one 1.2MB floppy disk drive, 20MB hard disk, \$4,999; Model 40 with 640K RAM, 40MB hard disk, \$5,799; 1,200-bps modem, \$349; modem card, \$50; DOS 3.3, \$120; carrying cases: nylon, \$89; leather, \$225.

**In Short:** The Portable III Model 40 is a 20-pound, 12-MHz 286 machine with a speedy 40MB drive and a high-quality gas plasma screen. It's a bit pricey and lacks internal standard expansion slots, but the quality is top-flight.

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#### FACT FILE

**Compaq Portable 386**  
Compaq Computer Corp.  
20555 FM 149  
Houston, TX 77070  
(713) 370-0670

**List Price:** Model 40 with 1MB RAM, one 5¼-inch 1.2MB floppy disk drive, 40MB hard disk, \$7,999; Model 100 with 100MB hard disk, \$9,999; 1MB RAM expansion, \$599; 1,200-bps internal modem, \$349; 2,400-bps internal modem, \$599; modem card, \$50; MS-DOS 3.2, \$95; MS-DOS 3.3, \$120; carrying cases: nylon, \$89; leather, \$225.

**In Short:** This is the portable computer with which others are compared. The Portable 386 is expensive, but it's very fast, has more than adequate screen and keyboard, and holds its own as an office desktop machine as well as a portable.

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## ■ 286- AND 386-BASED PORTABLES



▶ The 20-MHz Compaq Portable 386 is the powerhouse portable that set the standard for DOS-to-go. This \$7,999 lunchbox model includes a gas plasma display, an IBM Enhanced-type keyboard, a 40MB hard disk, and 1MB RAM, with a 100MB hard disk and 10MB RAM as options.



▲ The Compaq Portable 386's lack of internal expansion slots is its biggest liability. As with the Compaq Portable III, an optional \$199 expansion unit supplies two full-length expansion slots.

More than just a pricey status symbol, the Portable 386 is a dream machine for people who need a road computer that can handle large or speed-dependent applications—and who don't want to deal with transferring files between office and portable machines. This very classy lunchbox-style portable computer is the standard-setter for its configuration as well. Within its 16-inch-wide, 9.8-inch-high, 7.8-inch-deep box nestle a 20-MHz math coprocessor, 2MB of 32-bit RAM with room for 8MB more, a very fast 40MB hard drive, and a 1,200-bit-per-second modem. The gas plasma screen is a charmer with light-orange characters on a dark-orange background.

When carried in its black leather case, the Portable 386 attracts envious looks

from knowledgeable computerists—unless they're carrying them, too. Still, \$225 is a lot of money to pay for a carrying case, no matter how nice it is, and the Portable 386 itself elicits a similar response. The standard 1MB version without coprocessor or modem lists for \$7,999. The tested unit costs \$9,917. The \$225 case and \$120 MS-DOS 3.3 are extra.

At roughly 20 pounds, the Portable 386 is reasonably carryable. If you walk very far, you might want to buy a luggable carrier, but for short distances I found this system's weight acceptable—the well-designed case helps a lot.

The gas plasma screen has a 640 by 400 resolution that I found perfectly clear and readable. I don't work with graphics much, so I'm not bothered by the lack of

true aspect ratio, a shortcoming shared by all lunchbox-style machines. This off-spec ratio means that pie charts appear slightly flattened, for example.

The Portable 386's keyboard is the best Compaq has made to date. It has more action than previous units and has a layout similar to the latest keyboard from IBM, except that there are no extra cursor-control keys—just the typical dual-purpose numeric/cursor-control keypad.

Compaq uses its memory well, achieving near-zero-wait-state performance by holding pages of memory at once, saving significant amounts of time when referring to information already in memory. The Portable 386 has no internal standard expansion slots, but depending on the proprietary memory expansion board chosen,

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## ■ 286- AND 386-BASED PORTABLES

memory can be added in increments of 1MB, up to a system total of 10MB.

A 360K/1.2MB 5¼-inch floppy disk drive is on-board the machine. The tested version of the Portable 386, known as the Model 40, also comes with a 40MB hard disk drive with an average access time rated at less than 30 milliseconds. A Model 100 with a 100MB drive is available for \$2,000 more.

One parallel port and one 9-pin serial port are standard, as well as a port for an external RGB monitor. On the middle of the back of this unit, as with the 286-based Portable III, is an expansion port into which you can plug either an optional \$999 40MB tape backup unit or a \$199 expansion unit with two standard expansion slots, so you can add your own cards.

The Portable 386's documentation is first-rate. The Compaq also has a laundry list of other options. One of my favorites is an \$89 pedestal for desktop use that raises the unit and adds to the screen's adjustment potential.

The only drawback to this unit, other than its high price, is the fact that it creates a lot of heat. The screen has an automatic shutoff feature that lessens heat buildup somewhat, but occasionally the unit's internal modem wouldn't work after the computer had been running with heavy use for 4 or 5 hours or more. I found that shutting the computer down for a few minutes took care of the problem.

The Compaq Portable 386 is a machine that defines its genre. It's very fast and very capable. It has a fine screen, a good keyboard, and lots of expansion options. It comes at such a pretty penny that justifying those extra bucks may be tricky, but the Portable 386 is a terrific dual-purpose computer.—**Bruce Brown**

### DATAWORLD INC.

## Dataworld Portacomp II

If you've just got to have a luggable but don't want to spring for the heavy bucks most of these units cost, take a close look at Dataworld's Portacomp II. This machine offers a clear alternative to the other, more-expensive luggables reviewed in this issue. It combines a fair screen, a terrific keyboard, and fine performance with lower cost.



▲ At \$1,975, the 80286-based Dataworld Portacomp II is a cheap alternative to better-known 286 portables. Housed in a box nearly identical to that of the Compaq Portable III and 386, the Portacomp II doesn't sacrifice performance for price. The backlit supertwist LCD screen won't win any awards, but the Portacomp II provides two unoccupied full-size expansion slots, an optional 40MB hard disk, and a keyboard that's a pleasure to use.

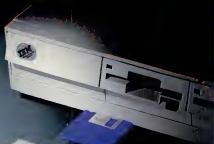
The Portacomp II is a 12-MHz 80286 computer that can be switched between zero and one wait state by means of an externally mounted toggle switch. The \$2,478 test machine came with 1MB of 60-nanosecond RAM, a 39-millisecond 30MB hard disk drive, and a single 720K

3½-inch floppy disk drive. The blue-and-gray backlit supertwist liquid-crystal screen is functional but doesn't win any awards when compared with the other screens in this group.

The Portacomp II case is similar to that used by the Compaq 386/20 and Portable

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## ■ PORTABLES



EDITOR'S  
CHOICE

### FACT FILE

#### Datamworld Portacom II

Datamworld Inc.  
3733 San Gabriel River Pkwy.  
Pico Rivera, CA 90660  
(800) 722-7702

List Price: With 512K RAM, one 3 1/2-inch  
720K floppy disk drive, 20MB hard disk,  
RGB port, \$1,975; parallel, serial, and game  
ports, \$59 (total); upgrade to 1MB RAM on  
motherboard, \$180; 32MB hard disk, \$70,  
I/O card, \$59; one-to-one interleaved drive  
controller, \$75; MS-DOS 3.3, \$99; carrying  
case, \$20.

**In Short:** The Portacom II is a value leader  
with fast memory, a fast drive controller, and  
a terrific keyboard. The screen isn't good  
enough for full-time desktop use but is fine  
for a computer on the go.

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III—an off-white color, big lunchbox  
type. After unhooking the keyboard and  
setting it on a table or desk, you must wrestle  
a bit with the screen, tilting it up and  
then forward and back until it settles in at  
about a 105-degree angle. The hinges on  
the back of the screen appear very strong,  
but the adjustment process was a bit  
rough—the lower edge of the screen often  
hit the bottom of the case. The abuse didn't  
seem to bother the Portacom II at all,  
however.

The keyboard is attached to the lower-  
right front of the case by a coiled cord that,  
if extended, lets the keyboard sit almost 3  
feet in front of the rest of the unit.

The keyboard itself is a pleasure to use.  
The keys have the elusive but desirable  
"click" and are spaced in an efficient pattern.  
Twelve function keys are arranged in  
a double row above the rest of the keys.  
The Esc key sits by itself on the top left,  
easily available but out of the way. There  
is a normal numeric/cursor-control keypad  
as well as separate cursor keys in an inverted-T  
formation just below the Enter key.  
The only odd key placement is the /? key,  
which is two keys to the right of the Right  
Shift key. The other key positions are similar  
to the standard "new enhanced" IBM  
keyboard. One additional key is a Turbo  
key for switching between 8- and 12-MHz  
operation.

The Portacom II weighs about 20

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- Prints statements.
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- Allows unpaid credit memos.
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- Supports service or product oriented businesses.
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- Prints packing slips.
- Prints invoices.
- Alerts user to customer exceeding credit limit.
- Sales history reports.
- Automatic updating of inventory daily.
- Allows return credit memos.

#### ACCOUNTS PAYABLE

- Can post to 200 general ledger expense accounts per invoice.
- Prints checks.
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- Processes credit and debit memos.
- Computes discounts and records discounts taken.

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## ■ 286- AND 386-BASED PORTABLES



### 286- and 386-based Portables: Summary of Features

(Products listed in ascending base-price order)

	 Dataworld Portacomp II	 Compaq Portable II	 Mitsubishi MP286L	 Sharp PC-7221	 Dolch P.A.C. 286-16
<b>AT A GLANCE</b>					
<b>Base price</b>	\$1,975	\$2,699	\$3,195	\$3,995	\$4,270
<b>Base configuration includes</b>	512K RAM, one 3 1/2-inch 720K floppy disk drive, 20MB hard disk, RGB port	Model 2: 256K RAM, dual 5 1/4-inch 360K floppy disk drives	Model 210: 640K RAM, dual 3 1/2-inch 1.44MB floppy disk drives, MS-DOS 3.3	640K RAM, one 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk, MS-DOS 3.2	1MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk
<b>Price of configuration tested</b>	\$2,478	\$4,443	\$3,995	\$3,995	\$4,645
<b>Configuration tested includes</b>	1MB RAM, one 3 1/2-inch 720K floppy disk drive, 32MB hard disk, upgraded 1:1 intensive drive controller, I/O card, MS-DOS 3.3	Model 4: 640K RAM, one 5 1/4-inch 360K floppy disk drive, 20MB hard disk, 80287 co- processor, MS-DOS 3.2	Model 220: 640K RAM, one 3 1/2-inch 1.44MB floppy disk drive, 20MB hard disk, MS-DOS 3.3	640K RAM, one 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk, MS-DOS 3.2	1MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk, MS-DOS 3.3
<b>Microprocessor type and speed</b>	80286 (0 or 1 wait state, 8/12 MHz)	80286 (8 MHz)	80286 (12 MHz)	80286 (8/8/10 MHz)	80286 (8/12/16 MHz)
<b>Screen type</b>	Backlit super-twist LCD	Cathode-ray tube	Cold cathode-ray tube, neutral twist nematic, backlit LCD	Backlit super-twist LCD	Backlit super-twist LCD
<b>Dimensions, HWD (inches)</b>	9.5 x 16 x 6.3	7.5 x 17.7 x 13.9	3.5 x 12.3 x 14.2	9.6 x 16.1 x 6.3	9.5 x 16 x 7.6
<b>Weight (lbs.)</b>	20	26.3 (Model 2: 25.6)	14.6	21.4	20
<b>MEMORY</b>					
<b>Minimum RAM</b>	512K	640K (Model 2: 256K)	640K	640K	1MB
<b>Maximum RAM</b>	1MB	41MB	2.6MB	1.6MB	8MB
<b>Supports LIM EMS</b>	○	○	●	●	●
<b>STORAGE</b>					
<b>Standard disk drives</b>	One 3 1/2-inch 720K floppy disk drive, 20MB hard disk	Model 4: one 5 1/4-inch 360K floppy disk drive, 20MB hard disk (Model 2: two 5 1/4-inch 360K floppy disk drives)	Model 220: One 3 1/2-inch 1.44MB floppy disk drive, 20MB hard disk (Model 210: two 3 1/2-inch 1.44MB floppy disk drives)	One 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk	One 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk
<b>Optional hard disks</b>	32MB (\$70), 49MB (\$264)	None	None	None	80MB (\$1,295), 170MB (\$2,495)
<b>Optional floppy disk drives</b>	External 5 1/4-inch 1.2MB (\$109)	Internal 5 1/4-inch 360K (\$225), 5 1/4-inch 1.2MB (\$275), 3 1/2-inch 1.44MB (\$245)	External 5 1/4-inch 1.2MB (\$499)	None	Internal 3 1/2-inch 1.44MB (\$50 upgrade fee)
<b>SCREEN</b>					
<b>Dimensions, H x W (inches)</b>	6 x 9.5	5.3 x 7	6.5 x 9	4.1 x 9.5	4.9 x 7.6
<b>Resolution (pixels)</b>	640 x 400	Text: 720 x 350; graphics: 640 x 200	Text: 640 x 400 (double-scan CGA); graphics: 640 x 200	640 x 200	640 x 400
<b>Readability</b>	G	E	G	F	G
<b>KEYBOARD</b>					
<b>Number of keys</b>	101	84	86	102	86
<b>Feel</b>	E	F	G	F	VG
<b>Layout</b>	Modified AT (12 function keys in two rows)	10-key numeric cursor keypad, 18 function keys	Modified AT	IBM Enhanced Keyboard	Modified AT
<b>Accepts standard external keyboard</b>	○	○	○ (external numeric keypad only)	○	●

▲ —Indicates Editor's Choice ● —Yes ○ —No E—Excellent VG—Very Good G—Good F—Fair P—Poor (Ratings are made by the reviewers and are relative to other computers in this review)

\*Only two of the portables reviewed here include batteries provided by the manufacturer: Zenith's SuperPort 286 and TurboPort 386. The TurboPort battery was a prototype, so although Zenith estimates the production version to have a battery life of 2 hours, PC Labs test results of the beta version were 1:31:56 (hours, minutes, seconds). Zenith estimates the SuperPort's battery life to be 5 hours; in our tests, battery life was 3:19:12. Other portable manufacturers such as Compaq and Dolch offer third-party batteries, but our tests were restricted to batteries provided by the manufacturer.





Compaq Portable III	Zenith SupersPort 286	Toshiba T3200	Deitch P.A.C. 386-20C	Toshiba T5100	Compaq Portable 386	Zenith TurboPort 386
\$4,999	\$4,999	\$5,799	\$7,470	\$7,499	\$7,999	\$7,999
Model 20: 640K RAM, one 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk	1MB RAM, one 3 1/2-inch 1.44MB floppy disk drive, 20MB hard disk, MS-DOS 3.21	1MB RAM, one 3 1/2-inch 720K floppy disk drive, 40MB hard disk, MS-DOS 3.3	1MB RAM, one 5 1/4-inch dual-density 1.2MB floppy disk drive, 20MB hard disk, 32K RAM cache	2MB RAM, one 3 1/2-inch 1.44MB floppy disk drive, 40MB hard disk, MS-DOS 3.3	1MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk	2MB RAM, one 3 1/2-inch 1.44MB floppy disk drive, 40MB hard disk, battery
\$6,510	\$4,999	\$7,498	\$9,190	\$7,499	\$9,917	\$7,999
Model 40: 11MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk, 80287 coprocessor, MS-DOS 3.3	1MB RAM, one 3 1/2-inch 1.44MB floppy disk drive, 20MB hard disk, MS-DOS 3.21	4MB RAM, one 3 1/2-inch 720K floppy disk drive, 40MB hard disk, MS-DOS 3.2	2MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk, 64K RAM cache, electroluminescent CGA screen, MS-DOS 3.3	2MB RAM, one 3 1/2-inch 1.2B floppy disk drive, 40MB hard disk, MS-DOS 3.2	2MB RAM, one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk, 80387 coprocessor, MS-DOS 3.3	2MB RAM, one 3 1/2-inch 1.44MB floppy disk drive, 40MB hard disk, battery
80286 (6/12 MHz)	80286 or 80C286 (0 wait states, 12 MHz)	80286 (6/12 MHz)	80386 (20 MHz)	80386 (8/16 MHz)	80386 (6/8/20 MHz)	80386 (0 wait states, 12 MHz)
DC plasma	H-ies backlight super twist LCD	Gas plasma	Backlit LCD; electroluminescent display (\$595)	Gas plasma	DC plasma	Page-white fluorescent backlit compensated super twist LCD
9.8 x 16 x 7.8 20	3 x 12.2 x 12.2 10.5 (with battery, 14.5 lbs.)	3.9 x 14.8 x 15.8 18.7	9.5 x 18 x 7.8 22	3.5 x 12.2 x 14.2 15	9.8 x 16.0 x 7.8 20	4.8 x 13.5 x 14.8 14.7 (with battery, 18 lbs.)
640K	1MB	1MB	1MB	2MB	1MB	2MB
6.5MB	2MB	4MB	8MB	4MB	10MB	3MB
●	●	●	●	●	●	●
Model 40: one 5 1/4-inch 1.2MB floppy disk drive, 40MB hard disk (Model 20: one 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk)	One 3 1/2-inch 1.44MB floppy disk drive, 20MB hard disk	One 3 1/2-inch 720K floppy disk drive, 40MB hard disk	One 5 1/4-inch 1.2MB floppy disk drive, 20MB hard disk	One 3 1/2-inch 1.44MB floppy disk drive, 40MB hard disk	One 5 1/2-inch 1.2MB floppy disk drive, 40MB hard disk	One 3 1/2-inch 1.44MB floppy disk drive, 40MB hard disk
40MB tape backup (\$999)	40MB hard disk (\$5,599)	None	80MB (\$1,295), 170MB (\$2,495)	None	100MB (\$4,299), 40MB tape backup (\$999)	None
Internal 5 1/4-inch 360K (\$225), 3 1/2-inch 1.44MB (\$245)	External 5 1/4-inch 360K (\$399)	External 5 1/4-inch 360K (\$499)	Internal 3 1/2-inch 1.44MB (\$50 upgrade fee)	External 5 1/4-inch 360K (\$499)	Internal 5 1/4-inch 360K (\$225), 3 1/2-inch 1.44MB (\$245)	None
5.1 x 8.3	8 x 8	5.5 x 7.5	4.9 x 7.8	5.5 x 7.5	5.1 x 8.3	6 x 8
Text: 640 x 400; graphics: 640 x 400	640 x 400	640 x 400	640 x 400	640 x 400	Text: 640 x 400; graphics: 640 x 400	640 x 400
VG	F	VG	E	VG	VG	G
84	79	85	86	82	91	79
G	E	G	VG	G	G	G
10-key numeric keypad, 10 function keys	Modified 101-key keyboard	Full-function with separate cursor-control and numeric keypad	Modified AT	Full-function with 8 cursor control keys and numeric keypad	10-key numeric keypad, 12 function keys	Modified 101-key keyboard
●	○ (external numeric keypad only)	●	●	●	●	●






(continues)

## ■ 286- AND 386-BASED PORTABLES



### 286- and 386-based Portables: Summary of Features

(Products listed in ascending base-price order)

	 Dataworld Portacom II	 Compaq Portables II	 Mitsubishi MP286L	 Sharp PC-7221	 Dell P.A.C. 286-16
<b>POWER</b>					
Battery*	None	None	None	None	None
Power supply	120/240V	120/240V	120/240V	120/240V	Auto-sensing from 90V to 250V
Car battery adapter	○	○	○	○	○
<b>I/O AND EXPANSION</b>					
External monitors supported by built-in video hardware	RGB, monochrome	RGBI (allows for color monitor)	CGA, monochrome (also in Hercules mode)	CGA, monochrome	RGB
Ports	None	1 serial 1 parallel	1 serial 2 parallel	1 serial 1 parallel (with CRT port)	2 serial 1 parallel
Slot type	3 full-size 16-bit, 1 full-size 8-bit	2 full-length 8-bit, 2 full-length 16-bit	4 proprietary half-length 16-bit	1 full-length 16-bit, proprietary slot for modem	3 half-length 16-bit 2 full-length 16-bit 1 full-length 8-bit
<b>STANDARD SOFTWARE</b>					
Disk-based	Phoenix setup for BIOS	None	MS-DOS 3.3, diagnostics	DOS 3.2, GW-BASIC 3.2	None
ROM-based	None	None	None	Setup	None
<b>OPTIONS</b>					
Math coprocessor	80287	80287	80287	80287	80286 or 80287
Modem	300/1,200/2,400 bps (\$138)	None	2,400 bps (\$499)	300/1,200 bps on internal card (\$369)	300/1,200 bps (\$130), 300/2,400 bps (\$240)
Carrying case	\$20	Nylon (\$89)	Nylon Cordura (\$99)	\$85	Nylon Cordura with leather trim (\$150)

 —Indicates Editor's Choice ● —Yes ○ —No E—Excellent VG—Very Good G—Good F—Fair P—Poor (Ratings are made by the reviewers and are relative to other computers in this review.)

\*Only two of the portables reviewed here include batteries provided by the manufacturer. Zenith's SuperPort 286 and TurboPort 386. The TurboPort battery was a prototype, so although Zenith estimates the production version to have a battery life of 2 hours, PC Labs test results of the beta version were 1:01:56 (hours, minutes, seconds). Zenith estimates the SuperPort's battery life to be 5 hours; its battery life was 3:19:17. Other portable manufacturers such as Compaq and Dell offer third-party batteries, but our tests were restricted to batteries provided by the manufacturer.

pounds, depending on the hard drive and other components specified. Packed in its nylon carrying bag with shoulder strap, the unit isn't exactly light, but it's a convenient machine to carry for short distances.

The tested unit had the following options: a RAM upgrade from 512K to 1MB; a disk controller upgrade to a Western Digital one-to-one interleaved unit for quick hard drive performance; an I/O card with one parallel, one serial, and one game port; a 32MB hard drive (20MB is standard); and the carrying bag. All of these options add only \$503 to the \$1,975 list of the standard unit—a very good deal. I can't think of one of these options I'd want to do without. MS-DOS is available for \$99.

If you want to add more to the machine, there are five expansion slots. In the deliv-

ered configuration, the one 8-bit slot held a video card with a 9-pin port for an external monochrome or RGB monitor. Easy-to-reach DIP switches let you configure the port to either Hercules or CGA compatibility. The other four expansion slots are 16-bit slots, two of which are available in most cases because the others hold the I/O card and the drive controller. A handy reset switch is located on the left side of the computer.

One omission in the Portacom II's box construction doesn't bode well for add-in boards. While add-in cards use standard bracket screws and end-guides, there is no device to hold the boards firmly in place. For a portable computer this is a definite disadvantage; we had two boards come loose in shipment.

The fan for the 105-watt power supply has a somewhat shrill, turbolike whining sound that soon drifts into the background but is a surprise on start-up, at least the first few times.

The Portacom II's screen is OK—not great, but passable. If this were your only computer, you'd probably want to hook it up to an external monitor for extended use. The screen measures 6 inches high by 9½ inches wide and displays in 640 by 400, double-scan CGA mode. This monitor does not display a true aspect ratio, slightly squashing the test pattern circles.

**FAST CHIPS** Dataworld likes to put fast memory chips in its machines, exceeding the normal specs for a 12-MHz processor by using 60-nanosecond RAM chips.

Compaq Portable III	Zenith SuperaPort 286	Toshiba T3200	Deich P.A.C. 286-20C	Toshiba T3100	Compaq Portable 386	Zenith TurboPort 386
None	Detachable nickel cadmium	None	None	None	None	Detachable nickel cadmium fast-charge
110V/220V	110V/220V	110V/220V	Auto-sensing from 90V to 250V	Auto-sensing from 90V to 250V	120/240V	110V
○	●	○	○	○	○	○
RGBI (allows for color monitor)	RGB	EGA	RGB	EGA	RGBI (allows for color monitor)	RGB
1 serial/1 parallel	1 serial/1 parallel	2 serial/1 parallel	2 serial/1 parallel	1 serial/1 parallel	1 serial/1 parallel	1 serial/1 parallel
In expansion unit: 2 full- length 8- or 16-bit slots	3 proprietary	1 full-length 16-bit, 1 half-length 8-bit	1 half-length 16-bit, 1 full-length 8-bit (in expansion unit: 3 full-length 16-bit)	1 proprietary	In expansion unit: 2 full-length 8- or 16-bit	2 proprietary
None	MS-DOS 3.21	MS-DOS 3.3, Lotus's Metro	None	MS-DOS 3.3, Micro- soft Windows/386	None	MS-DOS 3.21
None	Setup, diagnostics	None	None	None	None	Setup, diagnostics
80287	80C287	80287-8	80387	80387-16	80387	80387
1,200 tps (\$349), 2,400 tps (\$599)	300/1,200 tps (\$299), 2,400 tps (\$449)	None	300/1,200 tps (\$130), 300/2,400 tps (\$240)	1,200-tps Hayes-compat- ible internal modem (\$399)	2,400 tps internal (\$599), 1,200 tps internal (\$349)	2,400-tps auto/STNC (\$499 if purchased with system, \$699 if purchased separately)
Nylon (\$89), leather (\$225)	Nylon (\$59)	\$99	Nylon Cordura with leather trim (\$150)	\$99	Nylon (\$89), leather (\$225)	Nylon (\$79)

"Overspecing" won't make the computer run any faster but does lessen the chance that the chips won't be able to keep up with the system clock. The zero-wait-state capability also helps performance. The "turbo" 12-MHz operation can be cut back to 8 MHz with a single key, and the wait state can be increased to one, using the toggle switch mentioned above. Even though most software now has no trouble blasting along at these relatively high speeds, you might find some add-on cards struggling to keep up. Whether or not you need to cut back on speed, it's a plus that Dataworld made both controls so accessible.

Buyers can specify either Phoenix or Award BIOS chips when they order a Portacomp II, a nice pair of alternatives.

The Portacomp II's standard floppy

*Dataworld likes to put fast memory chips in its machines, exceeding the normal specs for a 12-MHz processor by using 60-ns. RAM chips.*

disk drive is a 720K 3½-inch drive. I'd prefer a 1.2MB 5¼-inch floppy drive if I could get it, but that isn't an option—though a 1.44MB 3½-inch drive is.

There is no room inside the Portacomp II's box for additional standard floppy or hard drives, but there is a floppy drive port on the back of the machine for an additional drive—the way to solve a problem with different drive formats.

You might not want this machine for your only computer without hooking up another monitor. And if most of the computers in your office still use 5¼-inch floppy drives, you'll need to find a way to convert to the 3½-inch format. Otherwise, the Portacomp II is a terrific value. This machine holds the distinction of being the only 286 portable reviewed here whose price can compete with the many under-\$2,000 286 desktops on the market. It's a high-speed 286 performer and very legible. —Bruce Brown

## ■ 286- AND 386-BASED PORTABLES

### DOLCH COMPUTER SYSTEMS Dolch P.A.C. 286-16

Here's a reasonable alternative. Dolch's 286 luggable machine is a good compromise if you're looking for functional portable speed, almost unlimited expansion possibilities, and an affordable price. Unless system speed is an absolute imperative, this computer might be just what you need for the office, road, and home.

The Dolch P.A.C. 286-16 is a 16-MHz 80286 computer with a system clock speed that's twice as fast as a "standard" IBM PC AT. While that doesn't mean that the 286-16 is always twice as fast as an AT, on our tests it was at least 1½ times as fast and

often came close to doubling AT performance.

The standard configuration for this 22-pound machine includes 1MB RAM, a 1.2MB floppy disk drive, a 20MB AT-level hard drive, two serial ports, one parallel port, and a good 640 by 400 backlit supertwist liquid-crystal display. There is also an external RGB monitor port. The machine I tested had a 40MB drive (a reasonable \$225 upgrade) and a \$150 carrying case. The case is OK, but it doesn't feel worth \$150; however, it is built for the Dolch unit, is heavily padded, and has compartments on each side with enough room for cables, software, and a few file folders.

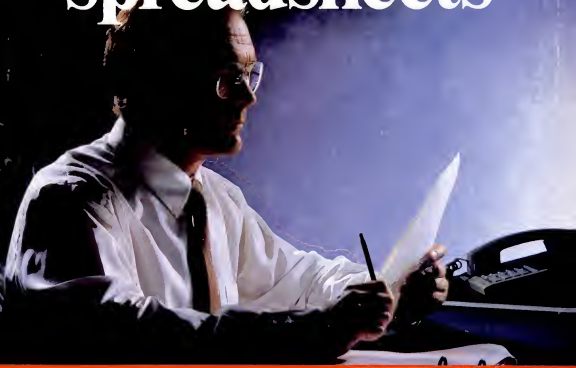
The \$4,645 list price of the tested machine is a significant piece of change, but half the price of the other Dolch unit reviewed, the 386-20C, which, as tested, lists for \$9,190. One of the hallmarks of the Dolch units is expandability. You could set up a 286-16 system costing over \$20,000 if you maxed out the RAM to 8MB (\$7,750 extra), put in a 170MB hard drive (\$2,495), added an 80287 coprocessor (\$1,075), upgraded to a gas plasma display (\$1,995) with an EGA controller (\$995), and added the maximum five expansion chassis modules (\$695 each). The ultimately expanded system would cost \$22,205, and you'd still have to shell out \$150 to buy MS-DOS 3.3. But such an ex-

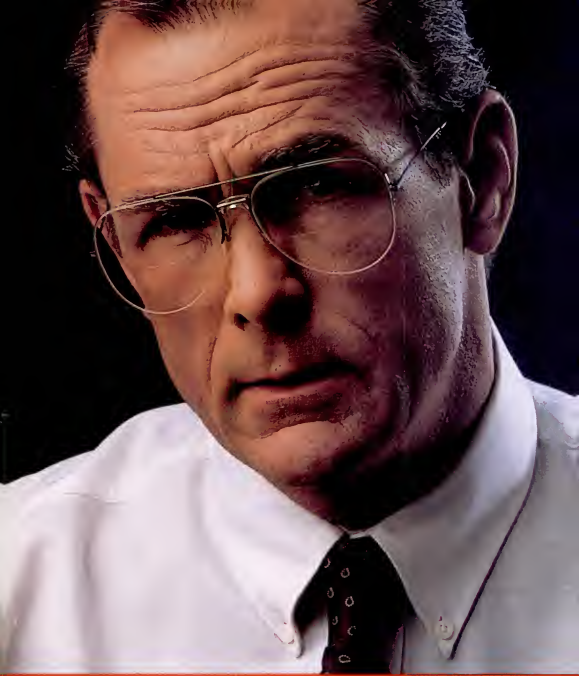
▶ The \$4,270 Dolch P.A.C. 286-16 is a 16-MHz luggable computer with a 20MB hard disk. Not enough memory? Dolch has options galore—a 170MB hard disk (\$2,495) and 8MB RAM (\$7,750 for a 7MB upgrade), to name just two. This 22-pounder is a solid, luggable expandable performer.



▲ With Dolch, expandability is the name of the game. The system includes six internal slots for expansion cards, and an extra \$695 will buy an expansion chassis with three full-size slots and a separate 200-watt power supply; a total of five such units can be added to your machine.

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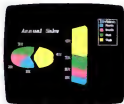
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  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
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Back

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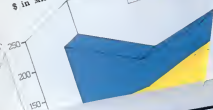
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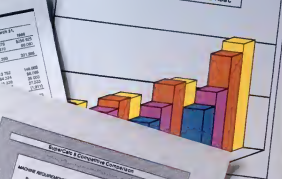
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Performance at 47 and 60.9 MHz should be					
<b>LOCAL I/O CONNECTOR</b>					
Optional 1.44 MB and Hard		Yes	Yes	No	No
Unit in 1.5 ft					
<b>A REPORTS WITH LINKS</b>					
4.5 Simulations (Figs)		Yes	No	No	No
Linear Data in Memory		Yes	No	No	No
Dynamic Links to Sheets on Disk		Yes	No	No	No
Microcode "Recompiler"		Yes	No	No	No
<b>VIDEO AND AUDIO FEATURES</b>					
Simulations developed and Auditing		Yes	No	No	No
Real Time Model		Yes	No	No	No
Track Error View		Yes	No	No	No
<b>ON QUALITY IMPROVE</b>					
in Linear Project Support		Yes	No	No	No
Simulate, Simulate, Error, Line		Yes	No	No	No
Guide Underline		Yes	No	No	No
<b>QUALITY GRAPHICS</b>					
Quality Graphics		Yes	No	No	No
View and Live		Yes	No	No	No
<b>W OF ADD IN Available</b>					
Formulas Available		Yes	No	No	No
Formulas Available		Yes	No	No	No
Formulas Available		Yes	No	No	No

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pansion spree would be silly for this machine. If you were to spend that much money, you should also pay the extra \$3,000 for the 386 20-MHz model with RAM caching and then take on all comers—although I'd hate to have to carry it around.

There is one option above the tested configuration that makes sense if you intend to use the 286-16 as both a desktop and a portable machine. While the backlit blue-on-gray LCD is pretty good, anyone who'll be putting in lots of hours with the 286-16 will probably prefer the \$595 electroluminescent display upgrade from the LCD. The EL's yellow-on-gray screen is a pleasure to use, even at CGA resolution. All Dolch screens work at a 90-degree angle but release from the bottom to pull out to a maximum of approximately 105 degrees. Graphics are not displayed with a true aspect ratio.

The Dolch units share the same system case, keyboard, and power supply. The dark gray case is handsome and, at 9.5 by 16 by 7.8 inches (HWD), relatively compact. The keyboard is a fairly simple affair, with 12 function keys across the top and with no duplicated control or cursor movement keys. The keyboard has a nice touch but feels just the slightest bit flimsy. The 200-watt power supply is more than

## COUNTERPOINT

My personal favorite among these machines is **Zenith's SupersPort 286**. It leans heavily toward the portable side of the equation, but with style and grace. The optional battery module gives you a real choice, without a permanent weight penalty. The expanded memory capability means that you don't have to go out on the road with crippled applications. The keyboard is the best of all the machines in the group. Ah, if only the SupersPort drove an EGA monitor . . . The **TurboPort 386** is Zenith's high-end machine. I like its innovative two-piece packaging. Unlike other members of our staff, I didn't mind the ridge around the keyboard, but I wish it used the same key switches as the SupersPort. They're infinitely better.

**Toshiba's T3200** looks enormous but travels well. The expansion slots open up a world of possibilities. The **T5100** shares the deft but clacky keyboard. In both cases, I wish that the Toshiba functions, such as speed, external CRT, and font, were marked on the keys. I was forever switching to CRT when I wanted the double-dot font. The T5100's EGA port is terrific; you can find or rent an EGA monitor almost anywhere you go. A good thing, too. Plasma displays are rapidly becoming yesterday's technology. They've never licked the color-to-bright-

ness-level conversion problem, which cripples today's increasingly graphic software.

The electroluminescent panel on the **Dolch P.A.C. 386-20C** is a perfect example of modern display technology. It's bright, readable, crisp, and yellow. It does a great job of depicting the eight CGA colors as brightness levels. The Dolch 386 makes me wonder why Compaq had to resort to the piggyback unit for expansion. Dolch manages to fit all the same stuff inside, with more slots, in a package that's more industrial than Compaq's but every bit as functional.

The biggest disappointment for me in the entire collection was the **Mitsubishi MP286L**. It's handsome, and has a great screen and drop-dead styling. The keyboard, however, is a mess. The function keys seem randomly placed, with little thought given to ergonomics or the way popular software uses the keys. This is Mitsubishi's first portable, and it shows. Just as Toshiba got it right on the T1100 Plus after a flawed entry with the T1100, I expect that Mitsubishi will do some active listening. This machine has the seeds of greatness, which makes its flaws all the more irritating.—**Bill Machrone**

*Bill Machrone is editor-in-chief and publisher of PC Magazine.*



## FACT FILE

**Dolch P.A.C. 286-16**  
Dolch Computer Systems  
2029 O'Toole Ave.  
San Jose, CA 95134  
(800) 538-7506  
(408) 435-1881

**List Price:** With 1MB RAM, one 5¼-inch 1.2MB floppy disk drive, 20MB hard disk, 86-key keyboard (with AT keyboard port), one parallel or two serial ports, RGB port (for color monitor), \$4,270; 40MB hard disk, \$225; MS-DOS 3.3, \$150; carrying case, \$150.

**In Short:** If you can do without 386 power, the Dolch 286-16 has the same expansion possibilities as the 386 models at lower cost. It's enough system for mobile computing, but the \$595 display upgrade is recommended if the 286-16 is to serve as a desktop machine as well.

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enough for the standard configuration, with plenty of extra capacity just in case you decide to add lots of power-hungry extras.

The system manages to pack in an impressive six slots for expansion cards: one 8-bit and five 16-bit slots. Three of the 16-bit slots are half length; the rest accommodate full-length boards. In the test unit, the half-length video card and I/O cards took two of the 16-bit slots and a full-length combination floppy-and-hard-disk controller card took another, leaving one short 16-bit slot and two full-length slots: one 16-bit and one 8-bit.

The system BIOS is the AMI November 1987 version. There should be no in-

compatibilities, but you should test your favorite or company-specified expansion boards ahead of time just in case, especially for traditionally more-picky interfaces such as network cards, and memory cards if you don't want to use Dolch memory upgrades.

The Dolch P.A.C. 286-16 is a good choice as a speedy dual-purpose workhorse. At \$4,645 as tested or \$5,240 with the electroluminescent monitor, it's not an inexpensive machine, but it's priced comparably to most other similarly equipped 286 portables. And if you ever win the lottery, the 286-16's almost unlimited expandability will let you add goodies galore.—**Bruce Brown**

## ■ 286- AND 386-BASED PORTABLES

### DOLCH COMPUTER SYSTEMS Dolch P.A.C. 386-20C

Dolch may not be a household word, but this company builds impressive luggable computers. The Dolch Pack-386, more formally called the Dolch P.A.C. 386-20C, is a fine piece of portable hardware that can easily serve double duty on your desk if configured wisely.

P.A.C. (Portable Add-In Computer) refers to the unit's expansion slots, which can take standard add-in cards. The unit tested had one 8-bit slot, four 16-bit slots, and one 32-bit slot. In addition to these slots, up to five Back Pack Expansion

Chassis modules can be added to a Dolch unit, each of which has three full-size 16-bit slots and a separate 200-watt power supply. It's possible, therefore, to have a single Dolch computer with a total of 21 expansion slots, though what anyone would do with all those slots is beyond me.

The main point is that you can roll your own Dolch, with four choices of display screens, several RAM configurations up to 8MB, loads of hard- and floppy-disk-drive choices, up to a whopping 170MB drive, a tape drive, and a math coprocessor. It just costs money—lots of it.

There are three Dolch 386 models and one 286 model (reviewed separately). The

386s come in 16 MHz, 20 MHz, and 20 MHz with a 64K RAM cache. Our test unit was the top-of-the-line model and included an extra megabyte of memory (added to the standard 1MB), a 40MB hard drive (upgraded from the standard 20MB drive), and an electroluminescent display (a supertwist backlit liquid crystal is standard). Adding the cost of these options to the 386-20C's \$7,470 list price brings the cost of the tested unit to \$9,190, including \$150 for a carrying case. MS-DOS 3.3 is another \$150. At these prices the unit had better be good.

And it is. The 386-20C with RAM caching is an extremely fast machine,

► *The 20-MHz Dolch P.A.C. 386-20C has a 64K RAM cache that makes it one of the fastest machines reviewed here. The \$7,065 price tag includes a \$595 screen upgrade, replacing the standard backlit supertwist LCD with a brilliant yellow-and-gray electroluminescent screen.*



▲ *A fully expanded Dolch can have up to 21 slots: 6 internal and 15 in a group of expansion chassis (\$695 apiece) with 3 full-length slots each. Keep in mind, however, that lugging around such a machine would not be a picnic.*







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### Dolch P.A.C. 386-20C

Dolch Computer Systems  
2029 O'Toole Ave.  
San Jose, CA 95134  
(800) 538-7506  
(408) 435-1881

List Price: With 1MB RAM, one 5¼-inch 1.2MB dual-density floppy disk drive, 20MB hard disk, one parallel and two serial ports, RGB port (for color monitor), 32K RAM cache, \$7,470. Model 386-16, with same configuration, \$5,770. Model 386-20, with same configuration but without RAM cache, \$6,470; electroluminescent CGA screen, \$595; 40MB hard disk, \$225; 2MB RAM, \$750; MS-DOS 3.3, \$150; carrying case, \$150.

In Short: On the same level as the Compaq Portable 386 in both speed and price, the Dolch P.A.C. 386-20C is a near-infinitely expandable, top-performing, 22-pound luggable.

CIRCLE 601 ON READER SERVICE CARD

cruising along with the fastest 386s on the market. The 386-20C takes on the Compaq 386/20 and performs at about the same level. The biggest differences between the machines are the way this unit can be expanded and the wide range of options.

The 386-20C weighs approximately 22 pounds in its heavily padded case, a formidable piece of luggage. Like most of the other units in this weight range, the 386-20C is certainly less bulky and heavy than the earlier generation of sewing-machine-style portable computers, but after carrying it a few city blocks this unit starts to gain weight rapidly.

The electroluminescent screen is very appealing in yellow and gray, but it achieves only CGA compatibility. Of course, you can always add an EGA controller for another \$995. The screen includes a brightness switch and a reverse switch, which switches between gray-on-yellow (my favorite) and yellow-on-gray. The screen measures 7¾ inches wide by 5 inches high. It doesn't display true aspect ratio in this configuration, so pie charts are slightly oval.

The 386-20C's keyboard is functional, if a bit bare. There is no separate numeric keypad and cursor control set. The layout is similar to the original AT keyboard; the

only major difference is that there are 12 function keys across the top of the keyboard. The keys clack and clatter, and though they work just fine, they feel a bit disconnected.

The review unit came with a 28-millisecond 40MB Seagate hard disk drive. At a premium of only \$225 over the standard 20MB drive, there's no good reason to stick with Dolch's minimum offering. Two serial ports and one parallel port are also standard, as is a 1.2MB 5¼-inch floppy disk drive.

There is no question that the Dolch P.A.C. 386-20C is a screamingly fast, high-powered machine. You can add as much power to it as you can afford and keep up with the fastest machines on the market. And with all this power by your side whenever you need it, how much more could you ask for?—Bruce Brown

### MITSUBISHI ELECTRONICS AMERICA INC.

## Mitsubishi MP286L

Mitsubishi's MP286L laptop portable may qualify for low-end status in terms of price, but when it comes to performance, this \$3,995 AT-class luggable is anything but low end.

The 80286 processor runs at 12 MHz with a single wait state, thus holding its own with most desktop units in its class. The hard disk is a 20MB unit rated at a rather pedestrian 68 milliseconds, which seems disappointing when teamed with its relatively hot CPU. Mitsubishi doesn't leave you hanging there, however; it adds PC-Kwik, a disk-caching program, to the package. With this program loaded using the default settings, the MP286L held its own with other 286s reviewed in this issue. On the small-record DOS file benchmark test, the caching cut out more than 90 percent of the time required for the same test run without caching.

While the caching program is yet another memory-resident program vying for precious RAM, PC-Kwik can use extended memory above the standard DOS 640K, limiting its impact on applications. The MP286L comes with only 640K on the standard model, but you can add a 2MB RAM expansion card.

The page-white display is attractive,

with black LCD characters on a white backlight background. The black characters are achieved using NTN (neutral twist nematic) liquid crystals, as opposed to the more-common super-twist LCDs that produce blue characters. The paper-white background is a cold cathode fluorescent panel, which uses technology similar to that of tubes used in overhead lighting fixtures. The end result is a good-contrast image that is relatively easy on the eyes. If you don't turn the backlight all the way up, you can get a pleasant mottled effect.

The backlight is not as bright as some, notably the other white panel I tested on the Zenith TurbosPort 386, but it is more than adequate. The LCD panel has 640 by 400 resolution with a standard 1.33 aspect ratio, so circles come out round and not squashed. The screen image is generated with a double-scan CGA emulation, however, rather than an EGA.

**STRANGE CHARACTERS** The biggest problem with the display is its character set, which reminds me of the problematic sets found on early dot matrix printers. The



## FACT FILE

### Mitsubishi MP286L

Mitsubishi Electronics America Inc.  
Computer Systems Division  
991 Knox St.  
Torrance, CA 90502  
(800) 556-1234, ext. 25  
(800) 441-2345, ext. 25 (in Calif.)

List Price: Model MP286L-210 with 640K RAM, dual 3½-inch 1.44MB floppy disk drives, \$3,195; Model MP286L-220 with 640K RAM, 3½-inch 1.44MB floppy disk drive, 20MB hard disk FXD, \$3,995; Model MP286L-220VP with 640K RAM, 3½-inch 1.44MB floppy disk drive, 20MB hard disk FXD, 80287 math coprocessor, \$4,595; 2MB RAM extension add-in board, \$1,530; one parallel and two serial ports, external floppy disk drive port, keypad port, external monitor port on CGA controller standard on all models.

In Short: Sleek, black, and fast, the MP286L represents an attractive value for an AT-class portable. The display's character set and keyboard are its weakest points, and its custom slots limit flexibility, but at \$3,995 it's more than simply competitive.

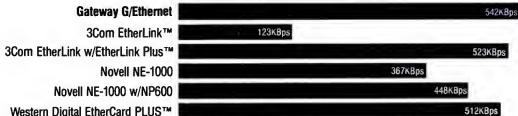
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## ■ 286- AND 386-BASED PORTABLES

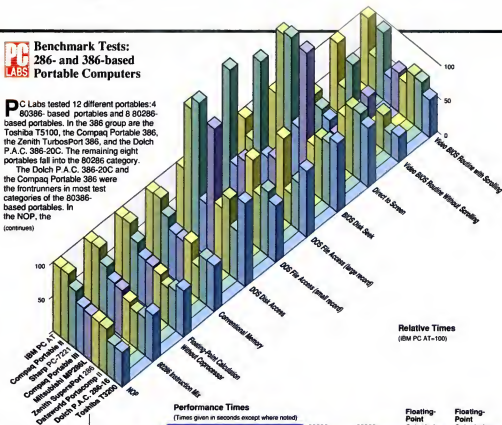


### Benchmark Tests: 286- and 386-based Portable Computers

**P**C Labs tested 12 different portables: 4 80386-based portables and 8 80286-based portables. In the 386 group are the Toshiba T5100, the Compaq Portable 386, the Zenith TurboPort 386, and the Dolch P.A.C. 386-20C. The remaining eight portables fall into the 80286 category.

The Dolch P.A.C. 386-20C and the Compaq Portable 386 were the frontrunners in most test categories of the 80386-based portables. In the NOP, the

(continues)



Relative Times  
(IBM PC AT=100)

In the NOP test, the Toshiba T3200, running a standard Intel 80286 processor at 12 MHz, proved to be the fastest machine in its class.

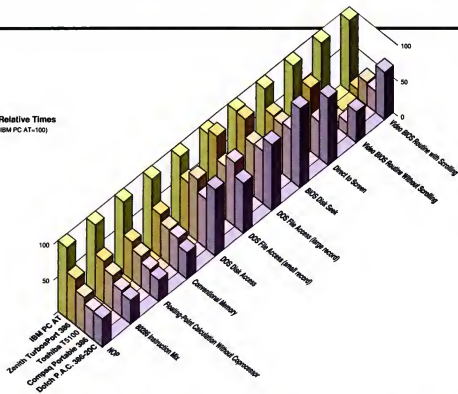
#### Performance Times

(Times given in seconds except where noted)

286-BASED COMPUTERS		80286 Instruction Mix	80386 Instruction Mix	Floating- Point Calculation with Coprocessor	Floating- Point Calculation without Coprocessor
NOP					
IBM PC AT, Model 339	4.18	8.79	N/A*	N/A§	35.43
Compaq Portable II	4.19	8.95	N/A*	3.80	35.83
Sharp PC-7221	3.50	7.36	N/A*	N/A§	29.20
Compaq Portable III	2.86	6.04	N/A*	2.29	23.76
Mitsubishi MP286L	2.78	5.84	N/A*	N/A§	23.29
Zenith SupersPort 286	2.78	5.14	N/A*	N/A§	22.19
Dataworld Portacom II	2.76	4.56	N/A*	N/A§	18.43
Dolch P.A.C. 286-16	2.11	4.76	N/A*	N/A§	20.10
Toshiba T3200	2.08	5.93	N/A*	N/A§	23.51
386-BASED COMPUTERS					
Zenith TurboPort 386	2.76	5.17	5.06	N/A§	18.95
Toshiba T5100	2.09	4.28	4.25	N/A§	15.36
Compaq Portable 386	1.68	3.29	3.25	0.61	12.48
Dolch P.A.C. 386-20C	1.65	2.97	3.02	N/A§	10.82

N/A \*—Not applicable: not a 386-based portable. N/A§—Not applicable: unit does not provide a coprocessor.  
N/A§—Not applicable: unit does not provide expanded memory.

Relative Times  
(IBM PC AT=100)



Conventional Memory	Expanded Memory	Extended Memory	DOS Disk Access (milliseconds)	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milliseconds)	Direct to Screen	Video BIOS Routine Without Scrolling	Video BIOS Routine with Scrolling
1.28	N/A†	N/A#	43.87	71.31	19.21	37.39	8.29	8.08	11.64
1.30	N/A†	N/A#	85.74	87.22	14.79	72.83	5.82	3.46	5.99
1.06	N/A†	N/A#	83.36	180.50	38.54	74.48	4.84	7.03	11.26
0.86	N/A†	11.91	33.16	66.79	13.46	29.00	4.28	2.42	4.61
0.85	N/A†	N/A#	85.08*	78.80	14.79	72.87	3.19	4.67	6.64
0.93	3.87	N/A#	38.54	86.37	22.34	25.85	6.21	1.98	5.93
0.60	N/A†	36.52	48.18	55.60	8.59	32.62	7.91	4.01	8.29
0.85	N/A†	N/A#	31.56	66.40	13.34	34.00	8.07	2.52	8.19
0.86	3.38	N/A#	53.32	58.44	18.40	37.44	7.14	3.02	6.26
0.77	N/A†	8.45	31.95	76.12	18.92	26.49	1.70	0.83	1.48
0.83	2.58	N/A#	38.45	52.64	14.01	25.60	7.38	0.71	3.85
0.60	4.73	N/A#	30.56	63.93	14.28	26.97	4.23	1.43	3.57
0.47	N/A†	11.56	40.96	50.20	17.90	41.63	7.68	3.47	7.79

N/A# —Not applicable; unit does not provide extended memory.

\* The Mitsubishi MP286L repeatedly reported hard disk errors while running this test with two different machines.

(continues)



## Benchmark Tests: 286- and 386-based Portable Computers

(continued from previous page)

Instruction Mix, the Floating-Point Calculation Without Coprocessor, and the Conventional Memory tests, the Dolch P.A.C. 386-20C outperformed the Compaq Portable 386. The Compaq's gas plasma display, however, was faster than Dolch's display on the Direct to Screen and the Video BIOS Routine tests. The Zenith TurboPort 386 failed to perform at the Dolch and the Compaq's level, with the exception of its superior performance in the screen tests.

In the 80286 family, the Dataworld Portacom II performed well in the Instruction Mix, the Floating-Point Calculation Without Coprocessor, the Conventional Memory, and the DOS File Access tests. In

the NOP test, the Toshiba T3200, running a standard Intel 80286 processor at 12 MHz, proved to be the fastest machine. Although the Mitsubishi MP286L was among the fastest 286s in the NOP and the processor tests, both of the MP286L machines we tested repeatedly reported hard disk errors on the DOS Disk Access test. Mitsubishi Electronics America uses varying hard drive vendors, even for the same model; the MP286Ls we tested had drives from Miniscribe Corp. The hard disk controller is a proprietary controller made especially for the Mitsubishi MP286L. The Sharp PC-7221's slow hard disk contributed to its poor performance in the hard disk tests.

All the portables were rated against performance times of the IBM PC AT, Model 339. As a matter of interest, the times for the Compaq Portable II were markedly close to those of the IBM PC AT in the Instruction Mix, the Floating-Point Calculation Without Coprocessor, and the Conventional Memory tests. No relative times are reported for the 80386 Instruction Mix, the Floating-Point Calculation with Coprocessor, the Extended Memory, and the Expanded Memory tests because the IBM PC AT was not outfitted to support these functions.

### PC Labs Standard Benchmark Tests

The NOP benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The 80286 Instruction Mix benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80286 instruction code. These instructions are a subset of the total processor instruction set.

The 80386 Instruction Mix benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 instruction mix implements a number of 32-bit operations; in the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The Floating-Point Calculation benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.1.

The Conventional Memory benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. (The result shown is the average of the read and write times.)

The Expanded Memory benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The Extended Memory benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The DOS Disk Access benchmark test measures the time it takes to do a random sector read using DOS. DOS buffers are set at 3 and the interleave factor is left at the drive's default setting. This test adds DOS's overhead to the BIOS and hardware times. The test program performs the sector read 1,000 times within the DOS disk partition. The average result is shown in milliseconds.

The DOS File Access benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing, text spreadsheets, files, loading a DOS program is also simulated by the large-record test. If no disk caching software is supplied by the computer or disk drive manufacturer, each test is run once. Otherwise, the test for each record size is run twice: once with the caching software installed and once without it.

The BIOS Disk Seek benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

The Direct to Screen benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.

The Video BIOS Routine Without Scrolling benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 80 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.

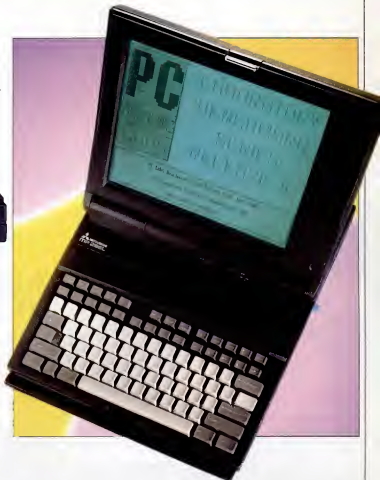
The Video BIOS Routine with Scrolling benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

(ends)

► The \$3,195 Mitsubishi MP286L is quirky, but its sleek black design and relatively low price tag make it an attractive choice. The keyboard's awkward function-key arrangement and the page-white display's bizarre character set are just two of this machine's idiosyncrasies.



▲ The four proprietary expansion slots in the Mitsubishi MP286L limit its flexibility, but this 15-pounder manages to fit them inside a clamshell-type housing.



characters have uneven thicknesses that are not visually appealing. The capital Y has top-heavy branches supported by a spindly upright base. The lowercase letters are worse: letters with descenders do not rest on the same level as those without, but instead float one pixel row higher. Letters with ascenders have the reverse problem: the body stops one pixel row short of the other letters. The result is text that bounces up and down unevenly—it not only was unattractive but more difficult to read.

The keyboard has its own troubles. The alpha keys are arranged much like the new 101-key layouts, with the exception of an unlabeled and undocumented key between the left Ctrl and Alt keys. This key pro-

duces a backslash character in DOS, but nothing in XyWrite. There is no separate numeric keypad, but one is embedded in the alpha keys and activated by the Num-Lock key.

So far, the keyboard is not much different from those of other portables. The problems arise with the function and cursor-control keys. To start with, they all have little half-size keycaps, which I found tough to use. The 12 function keys are arranged in three groups of four along the top left in an illogical arrangement. F9 through F12 are on one row, F1 through F4 in the row below. To the right in the second row come F5 through F8. It took some mental gymnastics for me to translate from the lo-

cations of any "standard" layout, making adaptation much more difficult. The cursor controls are at the top right, also in a strange configuration. On a regular keyboard, Home is above End and Ins is next to Del. On the MP286L, Home is in the same row as End and Ins is above Del. It is difficult to understand how these positions were chosen, since they seem designed to be as different as possible from conventional layouts.

Other than these quirks, the MP286L is a solid and full-featured machine. There are one parallel and two serial ports on the back, along with a port for an external CGA monitor and an external floppy disk drive, and four proprietary expansion



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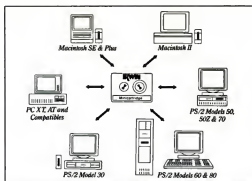
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slots. There is a hardware reset button on the display panel, located out of harm's way but within easy reach when needed. In addition to the hard disk, there is a 3½-inch floppy disk drive that reads both 720K and 1.44MB disks.

All this power is packed in a laptop case that tips the scales at under 15 pounds, which is within acceptable tote-weight range.

With performance nearing some of the slower 386 designs, low weight, fast storage through caching, and a list price of about \$4,000, the MP286L is an attractive value. The problems with the keyboard layout and the screen character set are somewhat subjective, but you'll want to check them out carefully to make sure that you can adjust to them comfortably, especially if you will also be spending time with more-standard keyboards. If these drawbacks are not significant, then you may find Mitsubishi's MP286L to be the right portable for you.—**Alfred Poir**

#### SHARP ELECTRONICS CORP.

### Sharp PC-7221

Sharp Electronics made the original lunchbox portable computer, and the PC-7221 is an acorn that has not fallen far from that first tree. With a list price of \$3,995, this machine retains many of its progenitor's features—some of which remain advantages, and some of which have not kept

## COUNTERPOINT

Of the dozen machines reviewed here, the **Dolch P.A.C. 386-20C** comes closest to the portable-desktop ideal. While the Dolch and Compaq Portables are the same shape, size, and weight, Dolch aces Compaq, three free internal slots to none. The crisp yellow electroluminescent screen draws just half the power of the Compaq/Toshiba plasma screens, yet you get better color-to-gray- (er, yellow-) scale conversion and somewhat better contrast. The keys sound hollow, the reset button isn't recessed (but at least it's there), and the case looks heavier than it is. All minor complaints. Now just learn to say "Dolch" without smiling. This is a serious machine.

Good looks, a big, crisp LCD screen, a 1.44MB floppy disk drive, and a competitive price will attract you to Mitsubishi's MP286L. But you've got to wonder about the lack of a battery option in a clamshell laptop. Ditto for the function key layout: F1 to F8 in one row, F9 to F12 just above. The Mitsu has an unmarked dead key on the bottom row (you press it, nothing happens). It should say, "This key intentionally left blank."

When the **Compaq Portable II** arrived in February 1986, it looked so tiny and powerful. Now this 26-pounder is the biggest and slowest of the group. The 9-inch green screen still provides the best

picture, although EL (electroluminescent) is catching up fast.

Zenith has done wonders with LCD screens. The page-white fluorescent illumination of the **TurboPort 386** makes the blue LCD dazzler of the Z-181, Z-183, and now the **SupersPort 286**, look positively dim. To me, the TurboPort keys sound hollow (maybe canyon echoes from the ridge surrounding the recessed keyboard). Zenith gets credit for offering an optional battery. But, Zenith, please think about speeding up the 12-MHz 386 chip in your next version, and take a look at those marvelous EL screens.

Among clamshell laptops, the **Zenith SupersPort 286** is the most well rounded: a big, well-lit screen with the same 4:3 width-to-height ratio as a desktop monitor, solid keyboard feel, and a clip-on battery. I wish Zenith machines didn't force you to double-up the cursor and PgUp-PgDn-Home-End keys.

You shouldn't base your choice on something as mundane as floppy disks, but if your office hasn't made the switch to 3½-inch drives yet, you'll want to look most closely at the three Compaqs, the two Dolches, and the Sharp. All have 5¼-inch drives. Zenith, Mitsubishi, and Toshiba (T5100 only) get credit for using 1.44MB microfloppies, which read and write 720K disks as well.—**Bill Howard**



#### FACT FILE

##### Sharp PC-7221

Sharp Electronics Corp.

Sharp Plaza

Mahwah, NJ 07430

(201) 529-9500

List Price: With 640K RAM, one 5¼-inch 1.2MB floppy disk drive, 20MB hard disk, \$3,995; 1MB RAM expansion kit for motherboard, \$499; expansion unit with two full-length and two half-length slots, \$699; 1,200-bps modem, \$399; MS-DOS and GW-BASIC, CRT port standard with the unit.

In Short: The PC-7221 is a lunchbox-style portable whose slow clock speed, slow disk drive, average price, and over-20-pound weight make it less attractive than other choices in the field.

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pace with advancing designs.

The housing is now an attractive charcoal gray, and the keyboard clips to the front, creating a single unit. The back of the case offers both serial and parallel ports and a connector for an external CGA monitor. The 80286 CPU runs at 10 MHz but can be switched to 8 or 6 MHz by using a slide switch on the back of the case.

The unit comes with a standard 640K memory, which can be boosted to 1.6MB by adding 1MB chips to the motherboard. There is a custom expansion slot that accepts an internal modem. Perhaps the best improvement over the original design is the full-size 16-bit expansion slot con-

tained in the bottom of the case. The extra slot makes the PC-7221 ideal for use as a roving workstation on a LAN.

The PC-7221 comes with a setup program in ROM, making configuration a snap. The documentation is excellent, with plenty of illustrations and lucid explanations of the computer's operation.

There are also numerous options available, including an expansion unit that accepts more standard cards. There is even a printer that is designed to hang on the back of the case, which you unhook and set up when you reach your destination. The handle on the case is designed to fit in either of two positions to allow for the change in the

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CIRCLE 371 ON READER SERVICE CARD



◀ The 80286 CPU of the 10-MHz Sharp PC-7221 can be switched down to 8 or 6 MHz via a switch on the back. This \$3,995 hunchbox model comes with a 20MB hard drive and can be boosted from its standard 640K RAM to 1.6MB by adding a 1MB chip to the motherboard.



▲ The Sharp PC-7221's control panel gives information about the disk drive, as well as ways to adjust the contrast, brightness, and angle of the supertwist LCD screen.

center of gravity when the printer is attached.

The supertwist LCD screen is fairly easy to read. The screen can be adjusted to only a rather narrow range of reading angles, however, so you must rely on the contrast adjustments if you'll be working on surfaces of varying heights. The screen doesn't have a standard 1.33 aspect ratio, so circles will appear squashed.

The keyboard is separate from the main unit and is connected to the machine by a coiled cord with modular jacks on each end. This means that you can't plug in your favorite full-size keyboard instead, as is the case with some of the competitors. The keyboard layout is fair. On the plus side, it offers a full numeric keypad on the

right side. There is another set of cursor-control keys and Ins and Del keys along the top edge, but I found them to be too far away for easy access. I much prefer to have them on the lower edge of the keyboard. The keyboard also has a full complement of 12 function keys, but they are arranged horizontally in two rows of six each and use small rectangular keycaps. The function key arrangement is crowded, and users of both old-fashioned (function keys to the left) and new-fangled keyboards (function keys in a single row along the top) will have to make an adjustment.

The computer performed as you might expect a 10-MHz 286 to perform. Unfortunately, the machine is equipped with a poky 78-millisecond hard disk drive,

which is well out of the league of competing machine's drives.

The slow drive is perhaps the most obvious example of what is wrong with this machine. The PC-7221 comes halfway to meeting the competition but fails to distinguish itself in any significant way. With a list price of \$3,995, the PC-7221 offers no price advantage over most of the other 286 machines. At 21.4 pounds, it is heavier than most. And at 10 MHz with a slow hard disk drive, it doesn't keep up with the competition in performance, either.

Cheaper, faster, or lighter, Sharp's PC-7221 would be a much more attractive value. Given its current configuration, however, I would have to recommend that you look elsewhere.—Alfred Poor

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CIRCLE 335 ON READER SERVICE CARD

## TOSHIBA AMERICA INC. Toshiba T3200

From Toshiba, the people who helped put computers on the laps of American commuters, comes the T3200. Unlike its smaller stablemates, it requires an AC power outlet to function. It also packs AT power into its case and offers the whole kit for a list price of \$5,799.

The most notable feature about the T3200 is its width. Pop up the display panel, and you will find a full-size keyboard, complete with a separate numeric keypad to the right and ten function keys across the top (with standard-size keycaps!). While some of the lunchbox designs offer key-

boards as complete as this, the T3200 stands apart from most of the laptop-style machines in terms of its keyboard.

The keyboard layout is similar to an old-style AT keyboard, though with a bit less space between the keys. I found that I kept hitting the Esc key when groping for the Backspace key, a mistake that has unfortunate consequences in some programs. Overall, the T3200 was one of the easiest layouts to adapt to, but if you prefer your regular keyboard, there is a socket in the side where you can plug it in.

When you power up the T3200, you will notice another striking detail: the screen is red. The gas plasma display offers high resolution with a standard aspect

ratio, including both EGA and Hercules emulations. The characters are sharp, but the panel background is fairly bright, reducing the display's contrast even when the controls are turned all the way up. As a result, I found the display to be more tiring over extended use than a standard CRT monitor; you may be more comfortable hooking up your desktop monitor to the system.

Again, if you prefer, you can hook up an external EGA monitor to a port on the back. A combination keystroke switches you from the plasma display to the external monitor or back again.

On the inside of the machine, an 80286 beats away at the frenzied pace of 12 MHz.

► *The Toshiba T3200 offers 12-MHz 80286 performance, a gas plasma display, and a 40MB hard disk. The red gas plasma screen has sharp characters but low overall contrast. Upgradable to 4MB RAM, this high-end 286 is heavy not only in features but in weight (19 pounds) and price (\$5,799).*



▲ *The full-length keyboard of the Toshiba T3200 is exceptional among laptop-style machines. The familiar layout, separate numeric keypad, and ten function keys with standard-size keycaps make the transition from desktop to portable keyboard practically painless.*





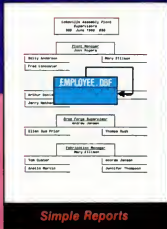
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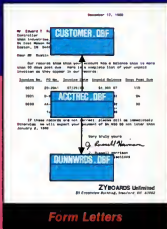
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CIRCLE 315 ON READER SERVICE CARD



12/8/87

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## FACT FILE

### Toshiba T3200

Toshiba America Inc.  
Information Systems Division  
9740 Irvine Blvd.  
Irvine, CA 92718  
(800) 457-7777  
(714) 583-3000

List Price: With 1MB RAM, one 3½-inch 720K floppy disk drive, 40MB hard disk, 80287 coprocessor socket, \$5,799; 3MB RAM expansion/extension card, \$1,699; carrying case, \$99.

In Short: The Toshiba T3200 offers features like no other AT-class luggable around: full-length keyboard, plasma display, and high desktop potential and expandability. These features come at a price, however: extra dollars and extra weight.

CIRCLE #78 ON READER SERVICE CARD

The computer comes with a full megabyte of memory as standard, and you can add a 3MB RAM upgrade. There is also a 720K 3½-inch floppy disk drive, and a 40MB hard drive rated at 40 milliseconds. If you want to add something, you can use either the half-length 8-bit or full-length 16-bit expansion slots.

With all this power in place, what more could you want?

Unfortunately, there are some aspects of the T3200 that limit its appeal. Perhaps the first and foremost factor is weight. Here is a computer based on the latest technology, cramming an AT-class machine into a case the size of a small briefcase; yet it tips the scales at 19 pounds—the same weight as some portables with old-fashioned CRT displays. The weight might be more acceptable if it included some batteries, perhaps, but the T3200 is strictly a plug-in-the-wall machine.

The fan and hard disk drive are appreciably noisy, even when compared with a standard IBM PC-XT. While the T3200 can be set up as a desktop substitute, using its various ports, you'll run into some interesting limitations. You can have an external floppy disk or you can have a parallel printer, but you cannot have both. These two functions are supported through the same physical connector, so you must choose one or the other.

The display shows only three shades of

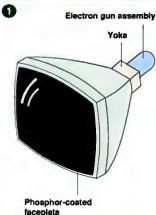


## The Evolution of Portable Screen Displays

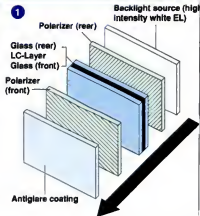
**C**athode-ray tube (CRT) technology, used primarily in desktop computers, was used in some early portables but quickly became cumbersome as portables shrank in size and price. Liquid crystal display (LCD) technology, used in the first portables and laptops and recently in low-end laptops, produces dim screens and low character resolution. The advantage of simple LCDs is that they are lighter and cheaper and consume less power, allowing for longer battery life than do more-advanced screen technologies. Backlit supertwist LCD improves upon basic LCD construction by adding a backlight panel for brighter screens and better contrast. Backlit supertwist screens have now become one of the standards for portables. Subsequent display technologies such as page-white screens and gas plasma displays trade longer battery life for higher contrast ratios and sharper images. Electroluminescent displays may be the wave of the future; while still power-hungry, the vivid yellow-and-gray, high-contrast screens use less battery power than gas plasma displays and offer longer screen life.

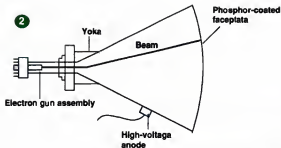
—Stephanie K. Losee  
and Francis P. Mitard

### CATHODE RAY TUBE



### BACKLIT SUPERTWIST LCD

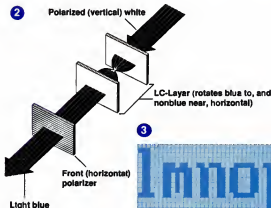




1 Cathode-ray tube (CRT) technology, used by the Compaq Portable II, is no longer used in laptops and portables because of its size and weight. The CRT display consists of a large, funnel-shaped glass tube. At the narrow end of the tube is an electron gun assembly that generates a beam of electrons that are accelerated through a deflection yoke. The beam is then deflected over the screen area by a magnetic field produced by the deflection yoke.

2 A beam of electrons is emitted by the electron gun and becomes magnetized as it passes through the deflection yoke. The electron beam then produces characters and images by exciting a phosphor coating on the inside of the screen, producing light wherever the beam strikes.

3 The Compaq Portable II's screen has the appearance of the IBM monochrome monitor, with green characters on a black background. The display sports high contrast and bright characters that are easy on the eyes. Overall, green phosphor on black is more soothing to read over long periods of time than some other color combinations.



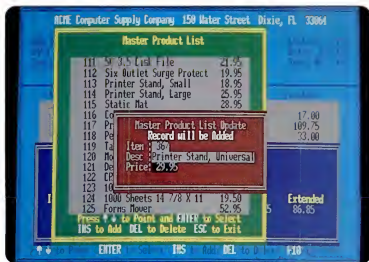
1 The backlit supertwist LCD (liquid crystal display), used in the Dataworld Portacom II, Sharp PC-7221, Dolch P.A.C. 286-16, and Zenith SupersPort 286, builds on standard LCD technology. The screen consists of a backlight source; a rear polarizer; a Twisted-Nematic (TN) LC-Layer surrounded on both sides by layers of glass; a front polarizer; and, depending on the manufacturer, an antiglare coating.

2 The supertwist LCD screen takes the liquid crystal molecules within a pixel (a picture element) and rotates them 90 degrees, yielding a light pixel. Dark pixels are developed when the liquid crystal molecules are transmitted directly between the two polarizers.

3 Backlit supertwist technology produces a bright screen with higher contrast for sharper characters. Unlike simple LCD screens, backlit LCD screens need no ambient light. The Zenith SupersPort 286 screen has dark blue characters on a light blue background.

(continues)

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## ■ 286- AND 386-BASED PORTABLES

red, which limits its ability to show different colors at one time. Toshiba includes a program that will look at the colors on the screen and assign shades so as to maximize the contrast between adjacent pixels, which is a handy and intelligent utility. The main drawback to this utility is that it happens to be yet another TSR (terminate-and-stay-resident) program that can clutter up your RAM.

The biggest problem with this machine is the list price. At \$5,799, the T3200 is the most expensive of the AT-level portables reviewed here. Its design does offer some advantages, to be sure, but whether those advantages are worth nearly \$2,000 more is open to debate.

The greatest strengths of the T3200 are its expansion slots, its 40MB hard disk drive, and its keyboard. Its major weaknesses are the weight and the price. If you need the storage space or the ability to add a network card or other option, then the T3200 might be worth the money and mass. Otherwise, the competition has the edge on both the scales and the bottom line.—Alfred Poor

### TOSHIBA AMERICA INC.

#### Toshiba T5100

Sometimes I think that there are two things Americans love more than baseball and apple pie: speed and mobility. Just look at our national love affair with the car. Or look at the Toshiba T5100, the computing world's equivalent of a 12-cylinder Jaguar: it's compact and powerful at a premium price.

Compact: the whole machine is about the size of the familiar low-end Toshibas and weighs in at 15 pounds. Powerful: lurking within this unassuming plastic package is an 80386 just waiting to cut loose, backed up by a full 2MB RAM and a fast 40MB hard disk drive. All this is yours for the not-inconsiderable list price of \$7,499.

Assume for the moment that you actually need a 386 machine and that you need to haul it from place to place. As long as there is an AC outlet waiting at your destination, your T5100 can be fired up and ready to run in just seconds. How well does this portable hot rod measure up against the competition, both from the

desktop and the more-mobile points of view?

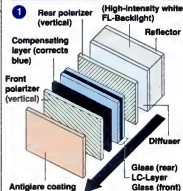
It is certainly fast. The 386 runs at 16 MHz, which is not as fast as the trailblazing 20- and 25-MHz screamers now on the market, but it is fast enough to make you forget your favorite AT. The hard disk clocks in at 25.6 milliseconds in the PC Labs benchmark tests, which is respectable for any desktop unit and downright unusual for a portable. The hard disk parks automatically on power-down and is one of the quietest drives I encountered in these tests. It has an EGA-compatible gas plasma display that provides high resolution with a standard aspect ratio, so your pie charts don't look like egg charts—all with a response time not rivaled by the fastest LCD screens.

But if speed were all there was to life, then we would be driving nitro-fueled dragsters to work every day. We expect more from our machines in the way of creature comforts. Here the T5100 shows some flashes of brilliance and some regrettable lapses of judgment.

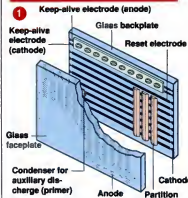
Most prominent in the good news/bad news department is the display, a red-tinted gas plasma screen with a number of options. For example, the screen has both brightness and contrast settings, which is good, but they both have to be cranked up to their highest settings for a legible screen, which is too bad. There are two character sets. One is a single pixel wide and is a bit taller than some people are used to, but it is fairly readable and quite sharp. I found it difficult to adjust to my EGA and NEC MultiSync combination after a session with the T5100 because my expensive color system ended up looking fuzzy and blurry by contrast. The other character set is two pixels wide and looks a little like a bad Broadway font except that it is even harder to read. You can easily switch between the two from the keyboard, which is good, but I can't imagine why you would, since the double-pixel character set is so lame.

**CAN I SEE A MENU?** The T5100 can display graphics and can simulate a color screen with different shades, which is good. Unfortunately, there are only three shades available (plus off), which is too bad. Some screens are totally unreadable

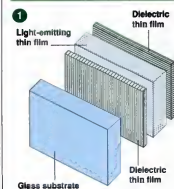
### PAGE-WHITE

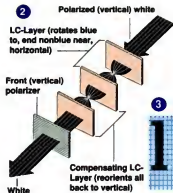


### GAS PLASMA



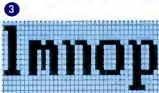
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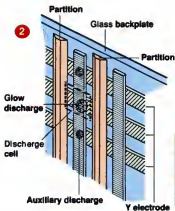


**1** Zenith's TurboPort 386 and Mitsubishi's MP286L use page-white technology. This screen type is based on backlit super-twist LCD construction. This screen technology consists of a high-intensity white fluorescent backlight, a diffuser, a rear polarizer, an LC-Layer surrounded by glass, a compensating layer (to correct blue light), a front polarizer, and an antiglare coating.

**2** Zenith's page-white screen rotates the light source 90 degrees between the rear polarizer and the LC-Layer, then twists it back between the LC-Layer and the front polarizer. This method produces a bright white background. To produce black, the liquid crystal molecules are twisted only once between the two polarizers. The page-white screen offers a contrast ratio of 20:1, a significant improvement over the backlit super-twist LCD's ratios of 8:1 to 12:1.



**3** The Zenith TurboPort 386 page-white screen's use of a fluorescent light source rather than conventional backlighting results in a measurably brighter background. Because of the increased contrast, characters appear darker against the bright white background. In this case the price for higher contrast is battery life, as the page-white screen consumes battery power to a greater degree than backlit super-twist LCD screens.

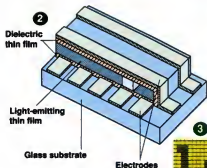


**1** The Toshiba T3200, Toshiba T5100, Compaq Portable III, and Compaq Portable 386/200 utilize gas plasma technology. Because gas plasma consumes battery power at such a fast rate, companies employ this technology primarily in AC-only portables. Gas plasma technology is based on the illumination of ionized neon gas to form the visible dots and pixels used for character sets and graphics.

**2** Inside the flat-screen plasma display is a cell structure array filled with neon gas. The display is placed between two parallel glass plates. The front surface is coated with transparent electrodes arranged in columns, and the back glass is coated with reflective electrodes arranged in rows. This arrangement creates a grid pattern with a resolution of 640 (width) by 400 (height) pixels.



**3** Gas plasma screens use a red/orange scale that is strikingly different in appearance from the other technologies reviewed here. Both Compaqs (here, the Compaq Portable III) offer a character set that is superior to that of the Toshiba; the Toshiba character set is not as bold.



**1** The Dolch P.A.C. 386-20C standard screen can be upgraded to a \$595 electro-luminescent (EL) screen that receives points for its superhigh contrast ratio and pleasing yellow-on-gray color combination. Electroluminescence is the light emission of a phosphor within an electrical field. EL displays have a one-piece solid-state construction that makes them thin, light, and durable.

**2** The EL display is a thin-film display that consists of a stack of extremely thin, vacuum-deposited layers of insulating dielectric film on a glass surface. These layers sandwich the phosphor within a thin, light-emitting film. Within this film, the pixels are defined by the intersection of row and column electrodes, producing images and characters.



**3** The Dolch P.A.C. 386-20C display provides a control to switch between yellow-on-gray and gray-on-yellow (as shown). EL displays provide the bright characters and high resolution of CRTs without their weight and size, making EL technology the likely inheritor for portable screens. EL screens are light and durable, able to take the kind of abuse expected of a portable computer. Soon portable makers may incorporate EL displays into battery-powered laptops, eliminating yet another sacrifice laptop users have been making for the sake of luggability.

Source: Electronic Products Magazine



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## ■ 286- AND 386-BASED PORTABLES

► *The computing world's equivalent of a 12-cylinder Jaguar, the 16-MHz 80386 Toshiba T5100 weighs in at 4 pounds less than the company's 286 offering and packs a fast 40MB hard drive, 2MB RAM, and a gas plasma display into a relatively small clamshell-style box for \$7,499.*



▲ *There's a price for compactness. Unlike Toshiba's T5200, the T5100 has a cramped keyboard layout that reflects the machine's smaller housing. The embedded numeric keypad is toggled on and off with an unlabeled combination keystroke.*



because the same shades represent different colors. For example, the PC Labs benchmark test program menus come out as a solid mass of brightness, leaving you to guess at the options. On the other hand, the T5100 has enough intelligence to examine the screen and readjust the grayscale assignments for the colors currently displayed, so that adjacent pixels show maximum contrast. This impressive sleight of hand can be triggered by a single combination keystroke, which is really quite good. Unfortunately, in order to gain access to this nimble facility, you must load a TSR (terminate-and-stay-resident) program, which is something that many users would prefer to avoid. Of course,

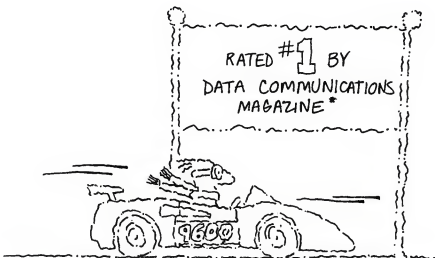
you can also drive an EGA monitor through the existing video port on the back of the computer, which can be toggled on by a different combination keystroke.

The biggest problem with the screen is that the background is fairly bright; it doesn't hold a solid, dark black. As a result, you end up with a lower contrast between characters and background, which I found more tiring to use than some of the higher-contrast machines tested here.

The rest of the computer is a set of similar ups and downs. There are many standard ports on the back, so you can add an external floppy disk, a printer, a serial device, or an external monitor. The same port is used for both the external floppy

disk drive and a parallel printer, so you are limited to one or the other.

The keyboard is typical Toshiba—a bit mushy except for a fairly stiff Spacebar. It has ten function keys, but you can get F11 and F12 through unlabeled keystroke combinations. The Ctrl key is in the “correct” position above the Left Shift, but the Backspace and Home keys are directly adjacent to each other. I found that I made many mistakes when reaching for the Backspace key in spite of its oversize keycap. The cursor-control, Ins, and Del keys are all conveniently located along the bottom-right edge of the keyboard, which is as good a place as any if you do not have a separate numeric keypad. There is a nu-



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## FACT FILE

### Toshiba T5100

Toshiba America Inc.  
Information Systems Division  
9740 Irvine Blvd.  
Irvine, CA 92718  
(800) 457-7777  
(714) 583-3000

**List Price:** With 2MB RAM, one 3½-inch 1.44MB PS-2-compatible floppy disk drive, 40MB hard disk, \$7,499; 2MB RAM memory card, \$1,299; carrying case, \$99.

**In Short:** Toshiba's T5100 delivers high performance in a lugable package. Some idiosyncratic features make this high-powered competitor less of a desktop-worthy machine than other 386s on the market.

CIRCLE 87 ON READER SERVICE CARD

meric keypad embedded in the regular keyboard, much like on the old Radio Shack Model 100, which is toggled on and off through an unlabeled combination key-stroke.

Setup of the T5100 is easy, thanks to the clearly illustrated and well-written manuals. The setup and diagnostic programs must be run from a disk file (as opposed to residing in ROM somewhere) and are stored under the unlikely and less-than-obvious name of TEST3.

The case is also a mix of good and bad. It is not too heavy, and the carrying handle doubles as a stand to raise the back of the unit, changing the keyboard angle. On the other hand, the screen is spring-loaded and secured by a single large catch that is at the bottom of the unit when you carry it by the handle. The lid often popped open when I tapped it against one obstacle or another. When you have both arms full, this setback goes from being inconvenient to definitely annoying. The optional carrying case is really a required feature if you intend to travel with this machine.

The T5100 is an interesting mixture of details done right and flaws that might drive some people nuts. If speed is your only concern, then you may be happy with this lugable, although you would do well to check out the other available 386 choices. If you expect more from your computer than raw speed and mobility, look at some of the design flaws to make

sure you can live with them. Remember that these problems will be part of a machine that you won't leave behind on your desk but will bring home and wherever else you need portable power.

—Alfred Poor

### ZENITH DATA SYSTEMS

## Zenith SupersPort 286

From the moment you take this sleek 10½-pound unit out of the box, you can tell that Zenith has found a way to pack power into a tiny package that weighs half as much as some of its competitors. You may hope to find some special features to justify the \$4,999 list price—a notch above most other 286 portables. My bet is that you won't be disappointed.

Like its bigger sibling, the TurboPort 386, the SupersPort 286 can operate from its own battery or an AC outlet. Unlike that of the TurboPort, the SupersPort's battery pack is simple to remove: it just hangs on the back of the machine with the aid of some rather hefty clips. The batteries bring the total weight up to 14½ pounds, which is still significantly lighter than some of the AC-only competitors. You will want to leave the batteries behind if you'll be carrying the computer for a long time, but otherwise you should leave them on. They act as a power conditioner and full-time uninterruptible power supply when your machine is plugged into a wall outlet.

The SupersPort also comes with the vivid blue supertwist LCD screen that the earlier Zenith laptops helped make famous. While not as bright as the new fluorescent white backlights, this screen still ranks as a strong second. The standard 1.33 aspect ratio and the double-scan CGA emulation make both graphics and text easy to read. The SupersPort also has one of the nicest LCD screen character sets I have seen.

The SupersPort is no performance slouch, either. The 20MB drive is rated at 28 milliseconds, and the 3½-inch floppy disk drive reads both 760K and 1.44MB disks. (Note that the high-density disks must have a hole across from the write-protect slide; the SupersPort cannot read a standard 3½-inch disk that has been formatted as high-density.)

The keyboard shares the same awkward

layout as that of the TurboPort, with Ins and Del stuck away in the upper-right corner. F11 and F12 are available in combination with the Fn key and the F1 and F2 keys. The Backslash is hidden under the Enter key, and there is an embedded numeric keypad. One of the few good layout features is the arrangement of the cursor keys in the lower-right corner, where they are easy to reach.

The feel of the keyboard differs from that of the TurboPort. There is no lip surrounding the keys, and, while slightly rattly, the keys themselves have a surprisingly solid and firm feel. The whole matter of evaluating keyboards tends to be highly subjective, but if you like the feel of the original PC keyboard, you'll probably find the SupersPort's to have an agreeable and familiar touch.

Most of the SupersPort's problems center around its case. In its favor the case is sleek, and the screen can be set to any angle, including flat "on its back" for times when you use an external monitor.

**PROTECTED PORTS** Unfortunately there are more minuses than pluses. There is no way to adjust the angle of the keyboard (a little flat for my taste) short of propping it up in the rear with a paperback. There are plenty of ports (serial, parallel, external monitor, disk drive) on the back,



## FACT FILE

### Zenith SupersPort 286

Zenith Data Systems  
1000 Milwaukee Ave.  
Glenview, IL 60025  
(800) 842-9000

**List Price:** With 1MB RAM, one 3½-inch 1.44MB "media-sensing" floppy disk drive, 20MB hard disk, \$4,999; 12-MHz system with zero wait states, battery, high-resolution backlit supertwist LCD, 40MB hard disk, \$5,599; expansion box for three full-size slots, \$499; 300/1,200-bps modem, \$299; 2,400-bps modem, \$449; carrying case, \$59.

**In Short:** The relatively high price of the SupersPort 286 is the biggest deduction from its appealing features of power and speed. The clean design and removable battery pack are pluses, offset slightly by limited expansion and port-access problems.

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ZEOS International, Ltd.



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At 10.5 pounds, the sleek Zenith SupersPort 286 weighs half as much as some of its competitors. The battery adds 4 pounds but allows you to work away from an outlet for over 3 hours. The \$4,999 price includes a 20MB hard drive and 1MB RAM. On the downside, this portable doesn't have the expansion possibilities of some other 286s, and you won't be able to replace the awkward keyboard with your own.



The battery pack limits access to the SupersPort 286's ports. The battery covers two of the four ports when it's hooked on—and makes opening and closing their protective panel impossible.

but the battery pack covers all but the parallel and serial ports. To make matters worse, there is a protective panel that covers the ports, but you cannot open or close it while the battery pack is on. As a result, if you travel with this panel closed and the battery mounted, arrive at your destination, power up, and then decide to print something, you must power down again and remove the battery pack to open the panel, hook up the battery again, and re-

boot. It merely takes time, but the process seems to be an unnecessary aggravation.

Another problem involves what isn't in the case: the power supply. Because the same unit acts as a charger for the battery as well as the main power source when running AC only, the SupersPort relies on an external box. The box is only about the size of a portable microcassette recorder, so it's more of a hassle than a real logistical problem.

The other case-related problems are the limits to expansion. The machine comes with a full megabyte of RAM, but you can add only another megabyte using the proprietary expansion slot, and then you are at maximum capacity. Some competitors go to 4MB or more, an increasingly important precaution in these days of uncertainty about the future of operating systems.

There are only two other expansion slots available: one for an internal modem

## ■ 286- AND 386-BASED PORTABLES

and one to hook up to an expansion interface. This means that you must purchase the expansion unit to make use of standard PC expansion cards. This liability could make it more difficult to use this computer

.....

*The batteries of the SupersPort 286 offer a practical benefit without forcing you to carry the extra weight.*

.....

for some applications, such as a roving workstation for a LAN.

The SupersPort comes with both diagnostic and setup programs in ROM, but they are part of a program called Monitor that is activated from the keyboard. The program menu looks a bit like EDLIN and also lets you read memory and registers, trace programs, and other esoteric techie stuff. The program may appear intimidating to a novice but would be a plus to those who can use it.

Overall, however, I truly like this machine. I find that the batteries offer a practical benefit without forcing you to carry the extra weight. The screen is clear and readable, and the keyboard is comfortable to use. The price of the SupersPort 286 puts it around the top of its class, so I would have to think a little harder before laying out my own money for it. But if I were to buy any of the 286 machines that I tested here, this would be the one.—Alfred Poor

### ZENITH DATA SYSTEMS

#### Zenith TurbosPort 386

Remember Transformers? Those toys that look like trucks or planes or cars or whatever, which a kid twists and turns to magically convert into a futuristic robot that has superpowers? The new Zenith TurbosPort 386 could well be the Transformer of portable computers, though at a list price of \$7,999 it's not likely that too many of us kids will find one in our stocking this year.

## PC EDITOR'S CHOICE

- Dataworld Portacomp II
- Dolch P.A.C. 386-20C

Our two winners aren't household names—yet. Portable PC makers still haven't come up with the ultimate desktop-replacing portable, but the Dolch P.A.C. 386-20C comes close. Similar in design to the Compaq Portable 386, the Dolch P.A.C. 386-20C competes at or above the Compaq's level for speed. Dolch provides three free internal expansion slots; Compaq provides two—if you buy a piggyback \$199 expansion box. The classy yellow electroluminescent screen has a high contrast ratio and depicts gray scales well. And when you arrive at your destination, you can even plug in your AT-compatible keyboard.

In the 286 family, the Dataworld Portacomp II is a marvelously cheap, powerful alternative to better-known portables. At only \$2,478 (compared with the Toshiba T3200's \$7,498 and the Compaq Portable III's \$6,518 price tags), the Dataworld outperformed the other 286s tested in this issue in most applicable benchmark tests.

The Dataworld is a Compaq knock-off in every way but the screen, which is a supertwist backlit LCD that's fine for travel but may frustrate you on a desk. If you don't mind plugging in your own monitor, you can save \$2,000 to \$5,000 without sacrificing power.

If your priorities are battery power and a 15- rather than a 20-pound weight, consider the Zenith TurbosPort 386 and the Zenith SupersPort 286. These machines deserve honorable mentions for packing desktop power into clamshell-style, battery-operable portables. While neither machine is the fastest or cheapest in its class, both have some winning features. The TurbosPort has a crisp page-white screen, a detachable (and replaceable) keyboard, and plenty of expansion possibilities. The SupersPort is lightweight, has a backlit supertwist LCD screen with standard aspect ratio, and a battery that will keep you going on the road for over 3 hours at a time.

At first glance, the TurbosPort looks much like any other flip-top portable, thick at the back and tapering to a carrying handle at one end. Slide back two catches and the mutation begins. The LCD screen housing is nearly 2 inches thick, and the handle is automatically pulled back into the housing as you raise the screen. Cleverly designed pivots and support arms hold up the open panel. Then you press two points at the back edge of the keyboard and it slides off into your hands to fit on your lap. Hit the power switch, and crisp black letters on a white screen appear as if by some alien power.

Presto—you have created something that more closely resembles a desktop machine with a new white-screen monitor

than a typical laptop.

Start an application and you will quickly see that the TurbosPort offers out-of-this-world performance, too. Inside beats a 386 heart (running at a sedate 12 MHz) backed up by a full 2MB of RAM and a 40MB hard disk.

As most any fan will tell you, not all Transformers are created equal, since each has its own distinct combination of strengths and weaknesses. The TurbosPort is no exception.

On the plus side, this is one of only two portables reviewed here and the only 386 luggable that includes a battery as a standard feature. It can give you 2 hours' work away from an outlet and serves double duty as an uninterruptible power supply.

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For one, they are the first memory boards to offer 100% EMS 4.0 compatibility. RampagePlus 286 has 12.5 MHz speed designed especially for fast AT compatibles, while Rampage-

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◀ The \$7,999 Zenith TurbosPort 386 houses a 40MB hard disk and 2MB RAM in a battery-powered fliptop portable. The 80386 processor's disappointing 12-MHz speed and the keyboard's bothersome traylike construction are this portable's biggest drawbacks.



▲ The page-white screen of the Zenith TurbosPort is one of its greatest assets, although its inordinately thick housing measures nearly 2 inches.

(The battery we tested was a production model and thus lasted only half as long as its projected life.) You can remove the battery pack to drop the total weight from 18 to 14.7 pounds if you can do without it.

**SOLID BLACK** More users will find the crisp and high-contrast LCD screen to be a major attraction. The screen's appeal comes from two sources. The LCD panel uses "compensating supertwist" crystals that filter out the blue light characteristic of normal supertwist screens. The result is solid black characters.

The other positive element of the Tur-

bosPort's display is the backlight. The machine uses a fluorescent light element, which gives a clear white background for the jet black characters, and the high contrast on the screen makes the TurbosPort easy to read under many lighting conditions. If you turn down the brightness, the backlight takes on a "mottled" look reminiscent of white marble, which I found I preferred. Even turned down, the TurbosPort's backlight was brightest of all the units I tested here.

There are other features to like about this computer. The keyboard detaches from the rest of the unit, as mentioned above, and comes with a coiled cable that

lets you get at least 3 feet from the screen. Don't like the keyboard? No problem; it connects using a standard DIN connector and is compatible with the standard AT keyboard, so you can simply plug in your favorite keyboard.

There are plenty of ports on the back: parallel, serial, video, and external floppy. There is even a proprietary expansion slot for a 2,400/1,200/300 Hayes-compatible modem.

The computer comes with its own battery-charging circuitry, so you don't need to deal with the inconvenience of a separate charging unit. There is a 3½-inch floppy disk drive that takes either 760K or

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2	06/16/90	BARBARA LEADY	1002	100.00	1	100.00
3	06/16/90	BARBARA LEADY	1003	100.00	1	100.00
4	06/16/90	BARBARA LEADY	1004	100.00	1	100.00
5	06/16/90	BARBARA LEADY	1005	100.00	1	100.00
6	06/16/90	BARBARA LEADY	1006	100.00	1	100.00

USE ARROW KEYS (↑) TO LOCATE APPROPRIATE UNIT PRICE FOR ITEM  
(←) - PREVIOUS PRICES TO CLIENT (Enter) - SELECT (Esc) - CANCEL/ITEM

ABRAXAS—DEPOSIT HEAD

ITEM	SOURCE	DATE	AMOUNT
1	BARBARA LEADY	06/16/90	100.00
2	BARBARA LEADY	06/16/90	100.00
3	BARBARA LEADY	06/16/90	100.00
4	BARBARA LEADY	06/16/90	100.00
5	BARBARA LEADY	06/16/90	100.00
6	BARBARA LEADY	06/16/90	100.00

DEPOSIT # 1001 SOURCE: DATE: 06/16/90 AMT: 100.00  
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## FACT FILE

### Zenith TurbosPort 386

Zenith Data Systems  
1000 Milwaukee Ave.,  
Glenview, IL 60025  
(800) 842-9000

**List Price:** With 2MB RAM, one 3½-inch 1.44MB floppy disk drive, 40MB hard disk, battery, \$7,999; 1MB memory expansion card, \$649; with 300/1,200/2,400-bps internal autosc modem, \$699 (\$699 if purchased separately); expansion box for three full-size slots, \$449; carrying case, \$79.

**In Short:** Powerful but heavy, the TurbosPort 386 comes with an internal battery as a standard feature. The black-on-white display offers excellent contrast but has some problems with interpreting colors. This portable is solid and flexible but not as fast as some of the competing 386 designs.

CIRCLE 476 ON READER SERVICE CARD

1.44MB disks, although the disk must have the appropriate hole across from the write-protect slide in order to be recognized as high density.

So what is there not to like?

To start with, the system runs at 12 MHz. While Zenith does want what it can to get maximum performance out of this speed, it is still slower than the other machines in this price class. However, the benefits of battery power and quality display should offset this difference for most users.

The case has some flaws. The catches that hold the display panel unit closed with the keyboard are small and awkward to use. It's too easy to think you have engaged the catches adequately, only to have them let go when you pick up the unit. If they were spring-loaded or engaged more firmly, they might be easier to use.

One of the case's better features is that each port on the back of the machine is clearly labeled. Unfortunately, the ports themselves are located under an inch-deep overhang, so it's nearly impossible to see the connectors when standing in front of the computer and craning your neck over the top.

The screen character set is good, except for the strange zero that uses a dot in its center instead of the more standard slash to distinguish it from a capital letter O. Like

most LCD screens I have seen, the display also tends to show vertical streaks of light and dark, especially on screens filled with text. Also, LCDs are inherently slower to respond than other technologies, such as the standard video phosphors. As a result, a rapidly changing display will churn into an unreadable blur.

A lesser problem is that the screen is limited to three different shades. You can scroll through different settings from the keyboard, which can do a good job of making color graphics legible, but it is difficult to get a good setting that shows both regular and bold text on-screen. The best that I could get was a dark regular text and a faint gray for bold.

**DEEP-DISH KEYBOARD** The keyboard is small, light, and rattly. It has a very soft feel, although it does provide some minimal tactile feedback. The layout suffers from major adjustment, with Ins and Del banished to the upper-right corner and the Backslash over beyond the Right Shift key. There are ten function keys across the top row, and F1 and F2 shift in combination with a special Fn key to make F11 and F12.

There is also a full numeric keypad buried among the letter keys, so there are many keys that can produce four or more results, depending on which shift keys are pressed at the time. To top it off, the keyboard has a half-inch lip raised all the way around, so that you feel like you are reaching down into a pan to find the keys. As a result of all these idiosyncrasies, I would judge the ability to hook up your own favorite keyboard to be a major advantage.

The documentation is thin. Explanations of some aspects of setting up and operating the machine are cryptic. For example, you can access the setup configuration and diagnostics programs through a ROM-based program called the Monitor. Unfortunately, this program is about as friendly as EDLIN. The help menu does list the Setup and Test options, but only after listing such unsettling choices as Examine Registers and Hex Math. This stuff is wonderful for computer engineers and tech types but can be a bit daunting to average users.

There are more flaws. The video port supports an RGB monitor but has a 15-pin

connector the size of a standard 9-pin D connector; you will need a special cable from Zenith before you can use your external monitor. The power supply comes in a separate box about the size of a videotape case, meaning that you have two power cables and a box to carry as well as the com-

*The display and power of the TurbosPort 386 make it enticing, but the keyboard flaws, display weaknesses, and other design shortcomings may make you hesitate.*

puter itself.

The power switch is a push-button toggle; you cannot tell by looking at it whether the machine is on or off. The floppy drive doesn't have a regular eject button; instead, when you press the button, you are requesting that the floppy be ejected, which the TurbosPort complies with after a short while. Fortunately, this same mechanism causes the floppy to be ejected when you power-down the computer.

If you can justify the expense of a portable 386, then the TurbosPort 386 may be worth considering. Its display and power make it enticing, but the keyboard flaws, display weaknesses, and other design shortcomings may be enough to make you hesitate. The TurbosPort 386 is probably as good as you can get right now for a portable 386, especially with clam-shell style construction, but you end up paying a price in more ways than one.—**Alfred Poor** ☐

*Bruce Brown is a principal of Soft Industries Corp., a Connecticut-based microcomputer consulting firm. He has taught computer science at several colleges. Alfred Poor is a microcomputer consultant based in Perkasie, Pennsylvania. He is a frequent contributor to PC Magazine.*



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Defragmenting programs—often called *defraggers*—take all your dismembered files and make them whole again. A simple defragger rearranges files so that each formerly fragmented file is in one piece. A *disk packer* takes this one step further: it “packs” all files into one area

(or several areas) of the disk, without leaving open space between individual files. This can help reduce future fragmentation by giving DOS fewer nooks and crannies in which to tuck little pieces of files when it writes those files to disk. This article covers both types of program, and many of the packages we looked at can perform both functions.

DOS needs more time to read a fragmented file than an unfragmented one because the disk heads have to jump back and forth to read all the parts of a file that are located in different places. If all of the file is in one place, the heads can stay in one place. If an application program needs to reread the same file hundreds of times when performing a single task—the way a

word processor continuously rereads its dictionary during a spelling check, or a database program continuously reads data during a sort—the task can take up to twice as long.

Many popular utility programs let you recover accidentally deleted files, or retrieve the original versions of data files that somehow got scrambled by a wayward application program. You can even recover files with DEBUG if you are sufficiently expert and have nerves of steel. Contiguous files are much easier to recover than fragmented files. When a friend's word processor recently decided to save only 25 bytes of a mail-merge file that was originally 80K bytes long, it took me 2 hours using *The Norton Utilities* to track down

## ■ HARD DISK DEFRAGMENTERS

every last bit of data from the lost file. The data had remained on the disk because DOS (Versions 3.0 and later) tries to write the new version of a file to a place different from the site of the earlier version; similarly, it tries to find a previously unoccupied area of the disk when you copy or create a new file. If my friend had used a defragger before reading the 80K file into his word processor, so that the original file was in one place on the disk, I would have needed only 2 minutes to recover the file.

**RESCUER OR DESTROYER?** Before you decide to use a defragger daily, keep in mind that it can make you lose deleted files permanently just as easily as it can help you recover them. If my friend had used a defragger *after* the file had been lost and before I started searching for its data, the defragger would almost certainly have covered the lost data with files that it defragmented and moved around the disk. Nothing short of a few months' work in an IBM computer lab (and a lot of luck) has any chance of recovering data that has been overwritten by other files.

Defraggers have other dangers because they constantly manipulate your disk's directories and file allocation table (FAT). Any time data files are moved around your disk, the directories and FAT need to be updated; otherwise DOS will never find your file again. The directory tells DOS where to find the first cluster of a file, and the FAT tells DOS where to find the remaining clusters. The FAT makes it possible for DOS to read fragmented files: it can tell DOS, for example, to jump from cluster 99 to cluster 777 to find the rest of the data in a file. If a program scrambles the FAT on your hard disk, it's time to reach for your backup copies, because your files are effectively gone forever.

Defraggers are luxuries. Like some luxuries, they demand as much time and effort as they save. With some of the more elaborate ones, you can spend an hour fine-tuning their style of operation in order to gain a few seconds over the course of a year. But if a disk packer helps you recover one deleted file, it will pay for itself many times over. And the satisfaction that comes from having a well-ordered disk has a subtle psychological value that shouldn't be scorned or ignored.

## HARD DISK GEOGRAPHY

A disk is divided into areas called *sectors* (normally containing 512 bytes each), although DOS stores files on disks in "clusters" of sectors. On hard disks larger than 10MB formatted under DOS 3.0 through 3.3, a cluster consists of four sectors and holds 2K of data. No file, no matter how small, can occupy less than one cluster. Larger files occupy all the clusters that they need. When you first copy files to a newly formatted disk, all the clusters in a file will be contiguous; that is, the file will fill an unbroken string of clusters. But when you delete a file, you make its clusters available to other files. And when DOS writes a file to the disk, it may choose to put the first few clusters in the free space left by the deleted file and put the remaining clusters in free space somewhere else on the disk. The result is a fragmented file. The more you modify or delete files, the more those modified files—and files newly copied to

your disk—become fragmented.

Since Version 3.0, DOS has been using a trick to help reduce file fragmentation, a trick that also helps in recovering lost data. During any single computer session, DOS avoids writing new data over areas of the disk that it had freed earlier in the same session when files were deleted or modified. Essentially, DOS maintains a pointer indicating the last place it wrote to on the disk, and that pointer only moves forward, not backward. So, if you delete a file, then copy a new file of the same length to the disk, DOS won't overwrite the area left by the old file but will place the new file in the first available area after the pointer's position. If the disk is more than 70 percent full, DOS changes its procedure and, working from the front of the disk, allocates the first available space. But the goal of unfragmented files is the same.—Edward Mendelson

If you want a packed disk without using a defragger, you can get the same result using the tools provided by DOS itself. But prepare to spend a lot of time shuffling floppies. Start by backing up everything on your hard disk—preferably twice. Then format the hard disk. Then restore the backup to the newly formatted disk. DOS will write each file to the disk in one piece. You can also do this with a tape backup, provided that you make a *file backup* rather than an *image backup*. An image backup will restore your files in exactly the same fragmented condition they were in when you started.

**SAFE PACKS** Before you touch any program that shuffles every last byte of data around on your hard disk, you ought to be confident that the program knows what it's doing. The best defraggers safeguard files by updating the FAT and directories immediately after moving any data, so that DOS will be able to find those files again. Even if the power from your local electric company stops during the milliseconds between the moment the program

writes a new defragmented copy of your data to the disk and the moment it tells the FAT where to find that data, your files should still be safe: the original fragmented copy of the data is still where it was before, and the FAT can find it in the old position if it hasn't updated to show the new. The only time it's dangerous to lose power is the instant the program is actually writing the new version of the FAT. But that moment is equally dangerous in DOS's COPY and DELETE commands.

You can interrupt some disk packers by pressing a key, and after a few seconds of tidying up, they will restore your data in pristine condition. But other defraggers try to gain speed by leaving all updates until they're finished and won't let you interrupt them while they work. If the power goes off while you are running one of these programs, your FAT will be fried beyond repair.

If you have a disk-packing program and use DOS 3.3's FASTOPEN command, you may be in for some terrifying moments. FASTOPEN is a special kind of disk cache that stores the locations of files



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## ■ HARD DISK DEFRAGMENTERS

in memory whenever DOS first looks for those files. When you run a disk packer or defragmenter, files are moved to different positions, and DOS can't find them where FASTOPEN expects them. If you try to run your word processor or spreadsheet, you may get a "File not found" message. If you try to run CHKDSK to see whether anything's wrong, you may get the same message. The solution is to reboot, so that FASTOPEN can find your files in their new locations. Several disk packers avoid the problem by forcing you to reboot when they finish; one of them forces you to reboot if it detects FASTOPEN.

Some disk packers let you arrange your files in a specific sequence that you can list in a "command file" or according to a general placement strategy that you can choose from a menu. You can place the programs you use most frequently near the FAT—the "front" of the disk—so that the heads don't have to jump a long distance from the FAT to the file and back again to read all the data. (The "front" of the disk is actually at its outer edge.) You can also place the files you revise most often near the "end" of the data—near the free space left after the files have been packed. This arrangement keeps holes from opening up near the front of the disk, since you don't often delete or change your program files, and helps keep fragmented files limited to a small area of the disk.

Less-elaborate disk packers sometimes move all the subdirectories on your disk (but not the files listed in those subdirectories) near the FAT to reduce head movement. This may sound like the most efficient arrangement, and in many circumstances it is. But if you tend to go back repeatedly to the same subdirectory for new files, it's more efficient to put the directory near its files, as some of the fancier disk packers do. DOS puts part of the FAT in a memory buffer whenever it reads the FAT from the disk. If the directory and file are close together, there's a good chance that the part of the FAT that covers the directory will be in memory at the same time as the file, and DOS won't need to go back to the disk when it needs to find the file.

In rare instances, a disk may actually seem to run slower after defragmenting than it did before. This almost certainly indicates

that the disk's interleave is set incorrectly and that the disk requires an extra rotation to read data that it should be able to read in one rotation. The error was masked when the files were fragmented because the heads were constantly on the move and didn't have to hover over the same tracks

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■ Although packers never squeeze data, you may find that you have a few more kilobytes free on your hard disk after you use a packer than before.

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waiting for the data to come around again. You can check and improve your disk's interleave with programs like Paul Mace Software's *Htest* and Gibson Research Corp.'s *Spinrite*.

**NO SQUEEZING** One common misconception about disk packers is that they squeeze your data into a smaller space and leave you with extra space on your disk. Last year a monthly computer magazine published a very strange review of disk-packing programs, complete with a chart listing the different percentages of disk space that each program supposedly released—with numbers ranging up to 20 percent. Those figures have absolutely no relation to reality. If you want to squeeze your files so that they fill less disk space, you need a compression program like System Enhancement Associates' shareware ARC utility or a similar program—like Vernon D. Buerge's ARCA and Phil Katz's PKARC. Keep in mind that you have to unsqueeze all squeezed files before you can use them.

Although packers never squeeze data, you may find that you have a few more kilobytes free on your disk after you use a packer than you did before. Your first terrifying thought will be that a file got lost in the shuffle. But don't reach for your backups. What happened is that the disk packer

tidied up your directories and released unnecessary space. Here's how.

When DOS creates a subdirectory (which is really a kind of file), the subdirectory occupies 2K (under DOS 3.3) and has room to list 62 user files. When you add files beyond this initial 62, DOS expands the directory by another 2K to accommodate 64 more files. But if you later delete files so that the total drops to 62 or less, DOS doesn't release the unused space in the directory. A disk packer routinely clears out all the entries in the directory that contain the deleted files (you won't need these because you can't recover deleted files after packing the disk), and if it finds that the directory is bigger than necessary, it reduces the size. The released space becomes free for new files.

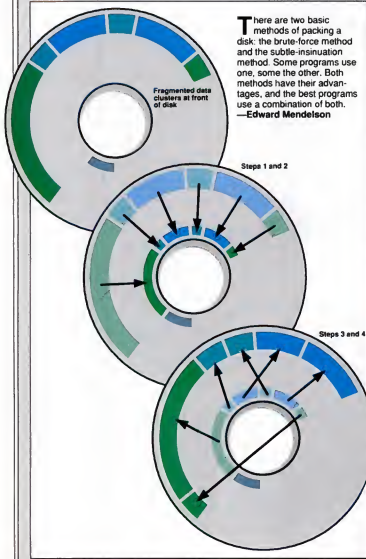
**HIDE AND SEEK** Disk packers and copy-protection schemes are traditional enemies. Most copy-protection schemes create hidden files (files that DOS doesn't list when you type DIR, although they have entries in the subdirectory itself); these schemes generally require those hidden files to stay in exactly the same place. Some even require the filenames to stay in exactly the same locations in the subdirectory listings. If a disk packer moves one of those files, the copy-protected program will refuse to run because it thinks you're using an illegal copy.

All disk packers refuse to touch the hidden files that DOS puts at the start of any bootable disk. Almost all disk packers refuse to move any hidden files at all (or any files in hidden directories), and some are smart enough to recognize standard copy-protection schemes and avoid all associated files, even when they aren't hidden. If your disk-packing program uses command files or has a menu-driven method for keeping individual files or subdirectories from being moved, you should specify every file and directory that contains a copy-protected program.

Despite all precautions, if you have copy-protected programs on your hard disk, you are truly begging for trouble. Although widely used copy-protected software such as *Lotus 1-2-3* is probably safe with today's advanced defragmenters, you will be even safer if you remove the copy protection with the help of one of the com-



## How Defragmenters Work: Two Styles of Packing It In



**T**here are two basic methods of packing a disk: the brute-force method and the subtle-insinuation method. Some programs use one, some the other. Both methods have their advantages, and the best programs use a combination of both.

—Edward Mendelson

### TOTAL UPROOTING

The brute-force method, in its extreme form, uproots and replants every cluster on the disk until the files and directories are in the desired order. It works like this:

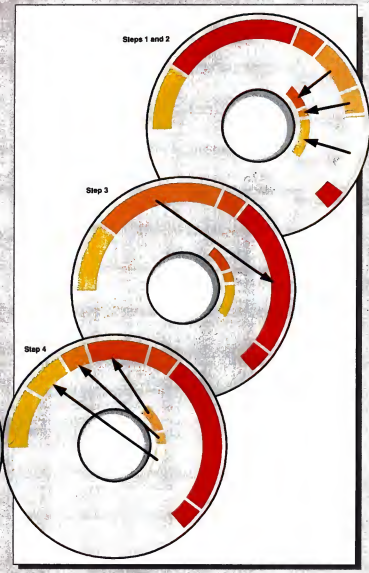
**Step 1:** Copy all occupied data clusters at the front of the disk to free space as far back on the disk as possible. **Step 2 (in safe programs):** Update the FAT and directories immediately to reflect the new locations. This step frees the space originally occupied by these clusters. **Step 3:** Find the files that belong at the front of the disk and copy them into the space freed by steps 1 and 2, making them contiguous in the process. Some of these files may include data found in clusters moved in step 1. **Step 4:** Update the FAT and directories to reflect the new locations of the files. **Step 5:** Repeat steps 1 through 4, but this time start by copying the data clusters in the area immediately following the clusters used in step 1.

### THOUGHTFUL EFFICIENCY

The subtle-insinuation method saves time and disk activity by leaving as many unfragmented files in place as possible, and figuring out how to find space between the unfragmented files in which to move all fragmented files and make them whole again.

This method has many variations but in essence works like this:

**Step 1:** Starting from the front of the disk, find a fragmented file or a "hole" of free space between two files. **Step 2:** If a fragmented file is found, leave the first fragment in place, and move enough of the following clusters elsewhere on the disk to make room for the remaining fragments of the file. Update the FAT and directories. **Step 3:** Copy the rest of the fragmented file into the opening created in step 2. Update the FAT and directories. **Step 4:** If a "hole" is found, look near the end of the disk for a file that will fit into the hole. Copy the file into the hole. Update the FAT and directories. **Step 5:** Continue across the disk until all files are packed.



mercial or public-domain programs designed for this purpose.

Some computer experts recently proposed a theory that the dinosaurs died out because they practiced copy protection. Some of the few remaining vendors who use copy protection today are scurrying to avoid the fate of the dinosaurs, and even Lotus recently released a \$15 disk that removes copy protection from 1-2-3. Meanwhile, if anyone tries to sell you copy-protected software that isn't a customized package intended for a special application, you can just say no.

**SPEED PACKS** Each defragmenter or packer leaves a disk in a different condition, and in deciding which program to choose, you should weigh the program's strategy and safety more heavily than the time it takes to do its work. We tested each program on an IBM PC AT with a 32MB hard disk that contained 836 files in 86 directories. These files, 21 of which were hidden, ranged in size from 1K to 500K. Of these files, 238 were fragmented into a total of 1,385 pieces, and 10.1 percent of the disk consisted of free space. This was as close to a worst-case condition as you are likely to find. If your disk is only half filled, or if you don't install new versions of your application programs every week, your disk is probably considerably less fragmented.

We told each program to pack this recalcitrant directory structure using the fastest method the program offered. All but two programs managed to pack the disk. Most of them did not thoroughly defragment all the files; wisely, they left the hidden files in place and did the best they could to fit the remaining files around the hidden ones. This is exactly what they should have done.

We tested how long the programs took to pack the disk—but keep in mind that a fast-performing program does not necessarily produce a better-performing disk. A program that takes a few minutes more to pack a disk may leave your files in a position that reduces access time when you start to work. And when a program takes a few extra seconds to arrange your files in a way that helps reduce future fragmentation, you'll end up using the program a lot less often than you would use its marginally faster rivals.

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## ■ HARD DISK DEFRAGMENTERS

As far as we could determine, when any of these programs defragmented a file, it left the clusters in correct sequential order. (If the clusters of a large file were left in a scrambled order, DOS would still be able to read the file correctly, but there could be a slight delay while DOS got them sorted out.) The one exception to this storage pattern would be if we had used an option in *Disk Optimizer* that places files at the farther end of a disk and arranges the clusters in reverse order.

Most of these programs are smart enough not to repack a disk that has been packed already, and shrewd enough to work quickly on a disk that has developed only a few minor breaks since the last time the program went to work. We point out any notable exceptions to this rule.

Some of these programs claim to be able to pack a fragmented disk with as little as one free cluster for data swapping. Some will work with no free clusters on the disk if you specify another disk as a swap area. These abilities have no practical value, as you would have to be out of your mind to pack a disk with no free space—it would take hours. Instead, copy some large files to floppies first, delete the files from the hard disk, then pack the hard disk and restore the files.

**STANDARD BRANDS** All of these programs will handle DOS's standard maximum hard disk partition size of 32MB. That means you can use any of these programs with a hard disk of any capacity, provided that the disk is divided into partitions of 32MB or less. Some programs (noted in the accompanying features table) will also work with the larger sizes introduced with Compaq DOS 3.31 and with many earlier specialized programs to create large disk partitions.

We tested all the programs on a DOS VDISK to see how they handled a disk that didn't correspond to standard hard disks. Two of them thoroughly demolished the VDISK's FAT and directories. You may want to hesitate before using these programs with anything other than a regular hard disk.

The most common disasters that occur with defragmenters and packers result from their interaction with disk cache programs. Some combinations of caches and packers

destroy all the data on a disk. The best caches won't cause this problem, and if the defragmenting program comes with a disk cache (like those in the *Mace Utilities* and *PC Tools Deluxe*), you can be confident that the cache and defragmenter work harmoniously together.

After backing up my disk twice, I ran each of the defragmenters on my home machine while using Multisoft Corp.'s intelligent cache, *Super PC-Kwik Disk Accelerator*. All worked perfectly. Your cache program may or may not be as clever. It's not a bad idea to boot from a clean copy of DOS (on a floppy disk) before running a disk packer. And keep your hands away from that power switch while the packer's running.

### Disk Optimizer

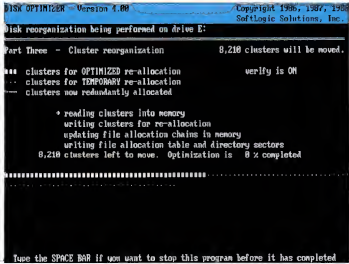
Don't be in a hurry to run SoftLogic Solutions' \$69.95 *Disk Optimizer* the first time you take it out of the box.

The program first asks you to type in your name on a registration screen. Then it dumps you back to DOS. When you run it a second time, you are confronted with an opening screen that offers a \$1,000 reward for any information that SoftLogic decides

to use in prosecuting any illegal use of the program. Only after staring at this screen for a moment or two do you actually get to work your way past the program's menus and defragment your disk. You'll see the reward notice the next two times you run *Disk Optimizer*. Then the notice goes into hiding for a while, only to pop up again at random approximately once every 15 times you start the program. SoftLogic admits that no one has ever been paid the thousand bucks the screen offers.

**A WELL-ORDERED PACK** When you run *Disk Optimizer* using its default settings, it packs your disk in a straightforward way. Files are packed in the order they appear in the directories. Files in the root come first, then a subdirectory, followed immediately by all the files within that subdirectory, then another subdirectory, and so forth.

This is one of the more common arrangements used by disk packers, but *Disk Optimizer* lets you do better. You can use a separate menu-driven program to specify the order in which you want your directories placed on the disk; the files in the directories you specifically name will be placed first, followed by all others. Al-



*Disk Optimizer's character graphics don't represent specific areas of the disk but indicate the number of clusters being written or read.*



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## ■ HARD DISK DEFRAGMENTERS

though the manual doesn't say so, you can place the directory you most often write to as the last one on the list, reducing fragmentation in the relatively stable directories near the front of the disk.

A separate directory-sorting program lets you arrange the filenames in each directory by name, size, or date. When you then run *Disk Optimizer*, the sequence on-disk will follow the arrangement you imposed with the directory-sorting program.

Another option lets you place executable program files together near the beginning (outer edge) or end (inner edge) of the disk. The manual suggests placing these program files near the end of the disk when your disk is more than 70 percent full and you are using DOS 3.0 or later. This will force DOS to write your data files closer to the front of the disk. But the disk will take longer to access the program files than it would if they were at the front. The command files in a program like *FastTrax* provide a better solution by letting you force data files and seldom-used directories to the end of the disk and frequently used program files to the front.

You can skip all these options and run *Disk Optimizer* in a fast mode that merely defragments all files without packing the whole disk or rearranging it into any special order.

**DATA CHECKING** *Disk Optimizer* normally tests whether the data written to the disk matches what the program read into memory. This verification is much stron-

ger than DOS's misnamed *VERIFY* function, which merely confirms that DOS can read the data, not that the data is correct. But unless your hard disk is in a very flaky state, you probably don't need to bother with any verification routine at all. You can store the verification option in the configuration file and override it on any subsequent run by using command-line parameters.

We tested *Disk Optimizer* in its default setting, but with the verification option turned off for greater speed. The program started slowly, with a long phase of direc-

### ■ *Disk Optimizer* lets you choose between full disk packing or a simple defragging of all files.

tory sorting and analysis. It required 31 minutes to pack the disk, including the initial analysis phase. The program left hidden files where they were and also left 13 fragmented files that were "interrupted" by hidden files, for a total of 18 breaks. Later passes over the same disk, when only a few files were still fragmented, were not very much faster because *Disk Optimizer* tends to move a large number of files and clusters even for simple reorganizations. It doesn't offer a disk map while it works but displays a statistical report on its progress and a few lines of stylized characters representing the clusters being read or written. You can interrupt the program safely by pressing the Spacebar.

*Disk Optimizer* isn't the fastest disk packer you can find, and its options, though extensive and ingenious, aren't necessarily the most useful. Many important menu choices aren't accessible at all from within the *OPTIMIZE* program but must be set with the separate *DOCONFIG* program. But the most useful option, the one that lets you choose between full disk packing or a simple defragging of all files, can be set directly from a command-line parameter. And this makes *Disk Optimizer* straightforward enough for the most impa-

tient user, as long as you don't mind starting at that reward notice on your screen every now and then.

## DOG: Disk OrGanizer

One of the least-expensive disk-packing programs turns out to be one of the most flexible. *Disk OrGanizer* (better known as *DOG*) is a \$20 shareware program released by G. Allen Morris III. You can find *DOG* on almost any bulletin board or order it from a user group's disk library. It's also available on PC MagNet. If you have some time on your hands and some advanced knowledge of DOS—and if you can tolerate the worst-spelled manual ever written—*DOG* may be all the disk packer you'll ever need.

*DOG* lets you pack a disk in one of four preset styles or write command files that will organize your files in any sequence or arrangement that you like.

If you run *DOG* without a command file, a menu offers four preset options: fast mode, which leaves all unfragmented files in place and tries to reorganize all fragmented files to fit in the remaining spaces; directory order, which arranges files in the order of the directory listings; packed order, which defragments files and leaves them in the same order as they occur on the disk; and fragmented order, an ingenious arrangement that packs all unfragmented files at the front of the disk and places after them all files that started out fragmented. If you choose fragmented order often enough, the files that you frequently work



### FACT FILE



*Disk Optimizer*, Version 4.0  
SoftLogic Solutions Inc.  
1 Perimeter Rd.  
Manchester, NH 03103  
(603) 644-5555  
List Price: \$69.95  
Requires: 128K RAM

(256K recommended), DOS 2.0 or later.  
**In Short:** A wide variety of options make this an attractive if not especially speedy choice among fully menu-driven disk-packing programs. Not copy protected.

CIRCLE 69 ON READER SERVICE CARD



### FACT FILE

*DOG: Disk OrGanizer*, Version 1.01a  
G. Allen Morris III  
1411-10th Ave.  
Oakland, CA 94606  
(415) 482-0532 (BBS number)  
List Price: Shareware (\$20 registration).  
Requires: 128K RAM (256K recommended), DOS 2.0 or later.

**In Short:** A crude-looking but effective shareware disk packer, with more options than most of the commercial competition. Not copy protected.

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John C. Dvorak,  
columnist, PC Magazine

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It's time you got personal about PROCOMM PLUS. Stop by and see us at booth 341 today. Or, call 314-474-8461.

## Thank You.



## ■ HARD DISK DEFRAGMENTERS

1. Fast - This is the fastest but will not always defragment all of the files and may leave more than one area of free space.
2. Directory - This will organize the files in the order they are in the directories.
3. Fragmented - This will put all of the fragmented files at the end of the disk after de-fragmenting them.
4. Packed - This will leave the files in their current order all of the files will be de-fragmented and only one area of free disk space will be left.

What is your choice? 1

Approximately 4193 clusters need to be moved to order the disk.  
6 directories need to be packed.

Do you wish to continue? Yes

Have you removed all of the copy protected software from disk E:7 Yes

Did you remember to inhibit any background or Multi-Tasking programs that read or write disk E:7 Yes

Packing Directories.  
Moving approximately 4193 clusters.  
19

Unless you use command-line switches or special entries in a strategy file, DOG: Disk Organizer asks you the same questions about backup and TSRs every time you run it. And it doesn't tell you much in return.

on will gradually work their way to the end of the disk, and further fragmentation will be minimized.

These menu options can also be specified from the DOS command line, along with options to stop DOG from asking whether or not you've removed copy-protected software from your hard disk and have cleared all resident programs from memory.

DOG's command files let you refine the order of your disk down to the last detail. You can force individual files to stay where they are, list other files and directories in the sequence you want DOG to use when rearranging them, and specify areas to be used for free space. You can also exile files to the area beyond the free space, at the extreme far end of the disk.

**RUN, DOG** We chose the packed order for our test and used a command file that simply told DOG not to waste any time using DOS's VERIFY function. DOG doesn't offer very much to watch while it is working; all you see is a counter that reports the number of clusters that DOG has moved. The program ambled across our hard disk in a leisurely 45 minutes and, because it wouldn't touch the hidden files, left 12 fragmented files with a total of 17

breaks. DOG won't allow you to press Esc to interrupt it, but the manual claims that if you reboot or pull the plug while it's running, you'll be able to recover your data by running CHKDSK.

Like all other programs found on bulletin board systems, DOG comes in a compressed archive file (DOG101.ARC) that

## ■ DOG's command files let you refine the order of your hard disk down to the last detail.

contains the program, manual, and related files. One of these is a small DOGMAKE program that helps in creating command files. A second programmer (who didn't bother to sign his name) created a more elaborate DOGMAKE program that can be found on BBSs as DOGMAKE.ARC. This program lets you refine your command files to the point where, for example, all .COM files between the size of 8K and 32K are conveniently arranged in alpha-

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SOFTWARE

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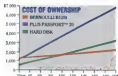
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CIRCLE 378 ON READER SERVICE CARD



## ■ HARD DISK DEFRAGMENTERS

betical order in one area of the disk.

Don't expect to use *DOG* or *DOG-MAKE* effectively unless you know enough about DOS to understand how to redirect standard output or use the *NUL* device driver instead of a file. If these terms are completely foreign to you, you can probably figure them out by squinting at the manual and experimenting. But it's probably not a good idea to get your advanced DOS education by playing around with programs that pack your hard disk.

The current version of *DOG* dates back to 1986. Version 2.0 is currently in beta test and may be available on bulletin boards by the time you read this.

An addendum to the *DOG* manual includes the statement that the latest version of the program has all its messages spelled correctly. This statement is misspelled.

### DOS Rx


Timeworks' \$59.95 *DOS Rx* package of utilities is an intriguing mix of features, some of them powerful and original, some clumsy and commonplace. The ingenious features make this program worth watching. The clumsy features are worth watching out for so that you can avoid them. The


disk packer in *DOS Rx* combines both kinds of features in one program.

The *DOS Rx* package consists of a memory-resident file manager and a stand-alone set of disk utilities. The file manager—a licensed version of WindowDOS Associates' *WindowDOS*—does a good job of viewing and manipulating files. The disk utilities, written by other unidentified sources, include the packer, a directory sorter, a file security system, and a disk and system tester.

The file security system is typical of the whole package—clever but far from bulletproof. The program takes a file's directory entry, which DOS expects to see in uppercase letters (such as *RX.EXE*), and rewrites it in upper- and lowercase (*Rx.Exe*). DOS refuses to access files whose directory entries aren't in uppercase, so the file is supposedly locked away until you enter a password that causes *DOS Rx* to restore the uppercase letters and make the file available again. The trouble with this scheme is that programs like *The Norton Utilities* unhesitatingly display the "locked" files and also let you rewrite the directory entries in uppercase.

The security system is a good idea imperfectly executed—and so is the disk

**FACT FILE**



**DOS Rx, Version 1.3**  
Timeworks Inc.  
444 Lake Cook Rd.  
Deerfield, IL 60015  
(312) 948-9202  
List Price: \$59.95  
Requires: 256K RAM,  
DOS 2.0 or later.

**In Short:** A fast, customizable disk packer with optional user-written strategy files but without the safety features in the best of the competition. The default strategy makes clever use of the system PATH. Not copy protected.

CIRCLE 68 ON READER SERVICE CARD

packer. If you run it in its default configuration, it cleverly arranges your disk so that all the files in the directories listed in your PATH setting are at the front of the disk, arranged in the sequence the PATH setting spells out. So if your path reads *PATH=C:\C:\BIN\C\UTILS*, your disk will emerge with all its subdirectory listings at the front of the disk, starting with *\BIN* and *\UTILS*, then all the files in the root directory, all the files in the *\BIN* subdirectory, all the files in *\UTILS*, and finally all the files in other subdirectories. Within each subdirectory the program files come first, followed by data files.

You can also write a strategy file that specifies the exact order in which to pack individual files or that lists the files and directories that you want the program to leave where they are. The syntax of the strategy file is a bit muddled. The manual spends a lot of time reminding you not to confuse the */s* switch that comes before a file specification, which means "sort by size," with the */s* switch that comes after a file specification, which means "apply the sort command to subdirectories."

**IMPRESSIVE SPEED** Our test setup used a simple PATH command that specified only the root directory, so *DOS Rx* had a relatively easy job of sorting the disk. It didn't wait around to display a disk map but sped across the disk in 16 minutes and left only 13 fragmented files, 5 of which had two breaks each. As with other programs, these breaks occurred because the



The one advantage of the dull *DOS Rx* screen display is that it doesn't mesmerize you into passive inactivity as the fancy disk maps presented by competing programs do.

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## ■ HARD DISK DEFRAGMENTERS



### Hard Disk Defragmenters: Summary of Features

(Products listed in ascending price order)

	SST: The Seek Stopper \$10 reg. fee	DOQ: Disk Organizer \$20 reg. fee	FastTrax \$49.95	VOpt \$49.95	Power Tools \$50.00	DOS Rx \$59.95	Disk Optimizer \$69.95	DS Optimize \$89.95	PC Tools Deluxe \$79.00
<b>SELECTIVE OPERATION</b>									
Defragments individual files or subdirectories	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Excludes individual files or subdirectories	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Packs and defragments whole disk	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Defragments all files without packing	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<b>HIDDEN FILES AND COPY-PROTECTION SCHEMES</b>									
Moves hidden files	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>
Moves hidden system files	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>
Recognizes copy-protection schemes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<b>SELECTIVE PLACEMENT OF FILES AND SUBDIRECTORIES</b>									
Puts subdirectories at front of disk	<input type="radio"/>	Optional <input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Puts files in specified directory at front or end of disk	<input type="radio"/>	Optional <input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Optional <input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Puts executable files at front of disk	<input type="radio"/>	Optional <input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Optional <input type="radio"/>	Optional <input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Offers fully customizable sequence	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has preset strategy settings	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Places files on single cylinders	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>MISCELLANEOUS</b>									
Works with partitions greater than 32MB	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Runs in batch mode	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Confirms that data written matches data read	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has disk-testing program	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>



—Indicates Editor's Choice

●—Yes

○—No

\*Depends on free disk space

program did not move hidden files but left room for them in the middle of ordinary files.

If we had had two hard disk partitions in the system, we could have increased this already impressive speed by specifying the second disk as a place where the program could temporarily store data while reorganizing the first disk. We could have increased the speed even further by specifying a RAMdisk as a swapping area.

All this adds up to impressive-sounding performance. You will be less favorably impressed by the dangers acknowledged in the manual. If you deliberately interrupt the program by pressing Esc, or if you lose

electric power, you are warned not to use the disk again until you go through an elaborate recovery procedure that requires running the program from a floppy disk. If you were interrupted by a power failure, you even have to boot from a floppy disk. You first reconstruct the settings you used when you began the program, then choose a Recover Prior Run option. You cannot choose to break out of the program without completing the whole disk-packing procedure.

The manual expects you to run the disk packer from a point-and-shoot menu that offers all the features in the package. Timeworks doesn't tell you that you can

run the program from the DOS command line simply by entering DO.

This is the first version of *DOS Rx*, and it has features that similar packages might envy. If the current version isn't the Rx for all disk dilemmas, a future version might well be a miracle cure.

### DS Optimize

Design Software lets you run the myriad options of its \$69.95 *DS Optimize* package from a series of elegant menus. You don't get as many different kinds of displays as you get in the average jet cockpit, but you come close.

PolyBoost II	Mace Utilities	Take Charge	The Norton Utilities—Advanced Edition
\$80.00	\$99.00	\$99.98	\$150.00
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<input type="radio"/>	<input type="radio"/>	Optional	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	Optional	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	Optional	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

You can pack a disk or defragment individual files or directories. You can tell the program not to touch files or directories that you select by name—up to a limit of five file specifications—and you can prevent it from touching files that have any combination of hidden, system, and read-only attributes. You can specify a "most-read" directory to put at the front of the disk and a "most-written" directory to put at the back, where fragmentation will have the least effect on the disk. You don't get the full range of options provided by the command files in some other programs, but you do get the relative convenience of menu-driven operation.

DS OPTIMIZE Version 1.10: (c) Copyright 1987 by Design Software

BACKUP	Rate	Sectors
ESTATE	Per Sector : 512	Per Cluster : 4
HNOFF	Per Cluster : 2,848	Per Drive : 41,628
LETTERS	Per Drive : 21,389,448	Used : 33,956
PROF	Used : 17,385,472	Available : 7,664
RECOM	Available : 3,923,968	
WORK		

BITS	Clusters	Optimize
BCO	Per Drive : 18,485	Clusters to move : 8189
BEZ	Used : 8,489	% of Drive : 88
CSD	Available : 1,916	Elapsed time : 00:00:35
DWF		% Complete : 3
TDF		

Optimize :E:\\*.\*

# of Subdirs : 7	Backed Up : No	File Exclude: No	Sort : No Sort
# of Files : 4	Subdirs : On	Att. Exclude: HSR	Type : Prot Test

Test Optimizing - Press any Key to End

DS Optimize keeps you up to date on statistics instead of showing a map. This screen shot was made during a "protected" (interruptible) simulated test optimization; the real thing looks almost exactly the same on-screen.

DS Optimize can pack your disk either in a fast mode that can't be interrupted without demolishing your data or in a "protected" mode that runs at almost half the speed but lets you interrupt it by pressing any key. A test version of each kind of backup checks for possible errors before attempting the real thing. Help for all these choices is available at the touch of a key.

We ran DS Optimize in its fast-and-dangerous mode and let it move all hidden files. It needed only 17 minutes to pack the disk, and it defragmented all the files. When DS Optimize is finished with a disk, most directories have all their files packed into one area of the disk, and the subdirectory itself is located just in front of its files. DS Optimize saves time by not trying to achieve complete consistency in this kind of organization; the files in some large directories may be packed into two separate areas of the disk rather than gathered into one area.

If you run DS Optimize on a disk already packed by a program that puts all directories at the front of the disk, it will reorganize the disk so that the directory storage is more to its liking. Curiously, if

you immediately run DS Optimize a second time on a disk it has just finished packing—even before you exit to DOS—it insists on moving one cluster. Later passes over a disk with only a few newly fragmented files take less time than the initial packing, but the difference isn't dramatic.

DS Optimize displays a small map of disk, directory, or file fragmentation, but it



## FACT FILE



DS Optimize,  
Version 1.10C  
Design Software  
1275 W. Roosevelt Rd.  
West Chicago, IL 60185  
(312) 231-4540  
List Price: \$69.95  
Requires: 256K RAM,  
DOS 3.0 or later.

In Short: This package offers more menus with more options than most of the competition, plus effective disk packing. It is ideal for users who prefer a menu-oriented approach. Not copy protected.

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  - 1.2MB Floppy Drive
  - Real-Time Clock/Calendar
  - One-Year Limited Warranty
  - Seven Expansion Slots: Five 16-Bit & Two 8-Bit

**\$2095**

## Standard-286/10



Editor's  
Choice  
Feb 16, 1988

"Overall, the Standard-286/10 appears to be one of the most attractive values... it comes with a good complement of manuals and software and performs precisely as you would expect. You should be happy with this one."

— Alfred Poor  
PC Magazine, Feb. 16, 1988

- 6MHz-10MHz Switch Selectable Speed
- 80286 Processor
- Ratas 9.4 on Norton's SI Benchmark Test 4.0
- 512KB RAM
- 5060, 5151, or 101-Key Enhanced Keyboard (Your Choice)
- Clock/Calendar w/Battery Backup
- One-Year Limited Warranty
- 200-Watt Power Supply
- 1.2MB Floppy Drive



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- Clock/Calendar w/Battery Backup

- 80286 Processor
- 200-Watt Power Supply

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## Keyboards

**5151**

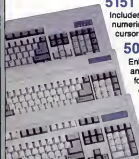
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**5060**

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**101-Key**

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# STARTER KITS

PC FullBak

**PC**  
MAGAZINE

Editor's  
Choice

May 31, 1988



## Professional Starter Kit **\$1515**

**Computer**-286/10 system with 80286 processor (switch-selectable 6MHz/10MHz processing speed), 512KB RAM (expandable to 1MB on motherboard), 8 expansion slots, 200-watt power supply, 1.2MB floppy drive, enhanced 101-key keyboard, dual floppy/hard drive controller, clock/calendar with battery backup.

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**20MB Hard Drive**-20MB hard drive, fully installed.

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**Software**-Professional Zen Software, a totally integrated software package: ZenWord™, ZenCalc™ and ZenLink™. MS-DOS® operating system, GW BASIC® programming language, and PC FullBak backup utilities also are included.

**Accessories**-200 sheets continuous form paper, printer cable, and 10 blank diskettes.

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**Software**-Professional Zen Software, a totally integrated software package: ZenWord, ZenCalc, and ZenLink. MS-DOS operating system and GW BASIC programming language also are included.

**Accessories**-200 sheets continuous form paper, printer cable, and 10 blank diskettes.

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Industry-standard 14" tube size EGA monitor (13" diagonal), EGA card, and I/O card with serial and parallel ports.

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#### Professional Starter Kit Options

	Monographics	EGA	VGA
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40MB	\$1640	\$2040	\$2190
60MB	\$1700	\$2100	\$2250

#### Video Options

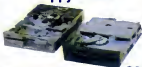
EGA option includes industry-standard 14" tube size EGA monitor (13" diagonal), EGA card, and I/O card with serial and parallel ports.

VGA option includes analog VGA monitor with 14" screen, .28mm dot pitch and 31.5KHz horizontal scan frequency. The VGA card supports high resolution (800x600) graphics and can display 16 of 256 colors at a time.

#### Career Starter Kit Options

	Monographics	EGA	VGA
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CIRCLE 29 ON READER SERVICE CARD

## ■ HARD DISK DEFRAGMENTERS

doesn't show a map of its progress while packing. Instead, you get a screenful of statistics, including the number of clusters remaining to pack, the elapsed time, and the percentage of work completed. Other menus in the program let you choose whether to sort directory entries, set screen colors, or run disk-testing and backup programs of your choice. A disk-testing program comes on the disk, although it isn't mentioned in the manual. If you dig a couple of menu levels down, you'll find a file manager that lets you make or remove directories and copy, rename, move, or delete files.

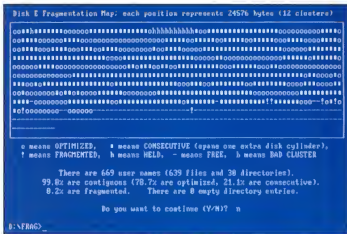
**CONFIGURATION FILES** An oddity of *DS Optimize* is the menu option that lets you save and load the full range of option settings. Both the menu and the manual say that you can save different sets of options to different configuration files and load them as needed. But when you try to save to anything other than the default configuration file, the program flashes a message saying that this function is "unavailable" and referring you to the help key for further information. The help key tells you that the function is available—although you just discovered that it isn't.

There's a way around this. If you want to use different configuration files, simply save different settings in different sessions and rename the resulting DSO.DEF when you exit. When you want to use one of these configuration files, rename it DSO.DEF, and *DS Optimize* will automatically load the settings in that file.

Once you've decided on the settings you can live with, you can ignore all the complex menus and simply run *DS Optimize* by pressing a couple of keys from the opening screen. The program rewards you with a packed disk, which you can obtain quickly and dangerously or slowly and safely. The choice is yours.

### FastTrax

Before deciding whether to buy Bridgeway Publishing Co.'s \$49.95 *FastTrax*, decide what you want from a disk defragmenter. If what you want most is a colorful screen with lots of dancing pixels, you'll be happier elsewhere. But if you want fast disk packing and defragmenting,



*FastTrax displays its disk map only before and after packing the disk. While the program runs, you see a report on the number of bytes that remain to be moved.*

and if you want the last iota of performance from your hard disk, and the safest and smartest defragmenter you can find, get on the phone and place your order now.

*FastTrax*, written by Mark Elfieid, packs and defragments like the best of the competition, but it doesn't stop there. Consider the way data is stored on a disk: a file can be unfragmented in the normal sense of the term but still divided between two cylinders. (A cylinder is the set of all tracks that are the same distance from the center of the disk.) The file might occupy the last three clusters on one cylinder and the first three clusters of the next.

Every other defragmenting program is satisfied with this arrangement, even though the drive has to waste time shifting its heads from one cylinder to the next to read the whole file. But *FastTrax* uses a refinement that other programs don't even attempt. It arranges files so that, wherever possible, each file resides on only one cylinder. The result is less disk activity and more-efficient operations.

**COMMAND FILES** *FastTrax* also helps you write optional "command files" that will arrange your files in any order you choose. (If you don't use a command file, *FastTrax* defaults to an arrangement that

places each subdirectory near its own files.) A utility that comes with the program examines your disk, then presents five different preset strategies for arranging your disk and suggests the one it considers the most suitable. Some of these strategies pack your least-used files at the far end of the disk and your most-used files at the beginning, leaving an open space in the middle for writing and revising your

EDITOR'S  
CHOICE

**PC  
USING**

## FACT FILE

**FastTrax, Version 3.8**  
Bridgeway  
Publishing Co.  
2165 East Francisco  
Blvd., Suite A1  
San Rafael, CA 94912  
(415) 485-0948  
List Price: \$49.95  
Requires: 192K RAM for 21MB disks,  
256K for 32MB disks; DOS 2.0 or later.  
**In Short:** A safe, flexible, fast disk packer  
with unique optimization methods and a wide  
range of options, including user-written strat-  
egy files. It is easy to use in its default set-  
tings, yet completely customizable. Not  
copy protected.

CIRCLE 66 ON READER SERVICE CARD

## ■ HARD DISK DEFRAGMENTERS

data. You can designate all directories, or all executable files, or any other file or group of files as top priority, high priority, normal, or low priority, and you can arrange them in any order. You can do all this within the program or use any text editor to modify a command file. You can be doubly safe and designate any copy-protected programs as immovable even if they don't use hidden or system files.

It takes time to fine-tune a command file, but the results can be dramatic. I shaved 10 percent off the time it takes to run my AUTOEXEC.BAT by moving all my start-up programs to the start of the disk. And 2 weeks after packing a disk with *FastTrax*, my disk showed far less fragmentation than it normally shows a few days after using another defrager.

**REWARDING RESULTS** You don't need to bother with a command file to get good results from *FastTrax*. In our tests, using the relatively slow option that packs the disk and defragments files (rather than merely defragmenting files), *FastTrax* took only 21 minutes to pack the disk and optimize most files on separate cylinders. Of all the programs that refused to move hidden files, *FastTrax* did the best job of placing the other files around the hidden files for the fewest breaks. Only 7 files ended up fragmented (out of a total of 836), and each had only one break.

When you run *FastTrax* on a drive a day or two after the first run, with a few newly fragmented files, the program typically takes just a minute or less to restore the drive to an optimal arrangement. And if you set up a command file using the program's suggestions, you will probably find that you have to rerun *FastTrax* less frequently than you would expect to run other disk-packing programs.

*FastTrax* also lets you choose from three levels of error checking. For total safety but the longest working time, you can tell the program to confirm that all data read from the disk matches all data written to the disk. Or you can tell it to use DOS's VERIFY function to make sure that the data written to disk can be read, without comparing it. Or in reliable systems, you can get top speed by turning off this kind of error checking entirely.

If you have a nonstandard drive that

you don't want to risk using with other disk packers, *FastTrax* has a unique option: you can create a special parameter file that lets you optimize your drive safely. The program generates this file automatically, and you can edit it to fix any anomalies.

*FastTrax* lets you interrupt it at any time and return to DOS. If someone trips over the power cord and *FastTrax* is stopped in its tracks, your data will still be safe. All you need to do is run CHKDSK /F when you reboot the computer to guarantee that the directory structure is intact. After taking the precaution of backing up my disk, then swallowing hard, I actually tried this. It worked.

With more power and more options than the competition, and with all available safety precautions, *FastTrax* is the closest thing you can find to the ultimate disk packer and defragmenter.

## Mace Utilities

Paul Mace's *Unfrag* program, part of the powerful \$99 set of *Mace Utilities*, is a solid, reliable performer. It won't do anything flashy, and, although respectably fast, it won't operate at lightning speed. But it does the job thoroughly and safely.

When you run *Unfrag*, it offers you two options for disk organizing: either pack and defragment the whole disk or defragment any fragmented files without packing. In normal operation, *Unfrag* doesn't move files or directories into any special order and doesn't offer a way to assign an order of your choice. But a third option—mentioned in the manual only under the uninformative heading "Batch Procedures" and accessible only when you use an unintuitive code as a command-line parameter—forces the program to organize the disk with entries in the root directory first, then all directories, then all read-only files, and then all files that remain.

Before starting, *Unfrag* calls on DOS's CHKDSK for a report on the state of the disk and gives you a chance to break out if DOS finds any errors. It would be safer if the program stopped by itself, but you get a second chance to break out after *Unfrag* then runs Mace's *Fragechk* program for a report on fragmented files and the number of fragments in each. If only a few files are fragmented, you can decide to stop before defragmenting. *Fragechk* can also be run independently.

*Unfrag* asks if you want to run Mace's *Remedy* program to test the disk and lock



The Mace Utilities disk map has the mood of late-night jazz. Any messages displayed by the program during this phase can optionally be sent to the printer or a file.

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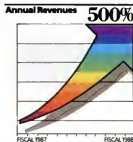


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## FACT FILE



**Mace Utilities, Version 4.11**  
Paul Mace Software  
123 N. First St.  
Ashland, OR 97520  
(800) 523-0258  
(503) 488-0224  
List Price: \$99; upgrade from earlier version, \$25 with original disk, 3½-inch disk on request.  
**Requires:** 256K RAM (32MB disk or larger requires \$12K), DOS 2.0 or later.  
**In Short:** Paul Mace's Unfrag utility has the virtues of all his other programs: it's safe and thorough, with options for fast action or complete reorganization. Not copy protected.

CIRCLE 884 ON READER SERVICE CARD

out any bad clusters before defragmenting. You can choose to run Remedy up to nine times or not at all. You can also choose whether or not to get a report on the results of Remedy and Unfrag, and whether you want this in a file or at the printer. Like the guardian of a bridge in a fairy tale, Unfrag does your bidding only after you answer all its questions.

Unfrag checks all files in sequence, and, when it encounters a fragmented file, moves other files until the fragmented file has enough room to become whole again. A deep-blue disk map sets an ideal mood for late-night defragmenting. You can safely interrupt the operation by pressing Esc and waiting for it to tidy up the disk before it stops. Unfrag confirms that the data written to an unfragmented file matches the data read from a fragmented one. The program forces a reboot when it exits unless it completes its work without moving any files.

**THOROUGH OPERATION** We chose Unfrag's disk-packing option, not the special option that also moves directories and read-only files to the head of the disk. The test disk was completely packed 37 minutes later, without any breaks in any files. (The documentation warns that the special option would have taken as much as two or three times longer.) A second run, when the disk has only a few fragmented files, typically takes about half this time.

Unfrag was the one of the few programs that completely unfragmented all files. Unlike many other disk packers, Unfrag moves hidden files if it doesn't recognize the characteristic signature of a copy-protection scheme in the files themselves. But it correctly refuses to move files that have both the hidden and system attributes set. When we ran our test a second time, after setting the attributes of one file so that it was marked as a hidden-and-system file, Mace allowed an ordinary file to break into two fragments on either side of this file. A printed slip lists some programs that use copy-protection schemes that are totally incompatible with Unfrag.


Although Mace can handle many types of hard disk partitions larger than 32MB, you are warned not to use it with certain specific versions of partitioning software. Unfrag normally requires 330K of free RAM (440K when run from Mace's optional menu), but a special version included on the disk will work with 256K machines.

The Mace Utilities includes powerful disk-testing, file-recovery, and format-recovery programs. They're not as elegant as those of *The Norton Utilities*, but if you use two or three of the Mace programs in combination, you can repair a scrambled disk and recover fragmented deleted files with an ease the Norton often can't approach. And Mace's disk packer is just what a straightforward program of this type should be: solid, steady, and sure.


## The Norton Utilities—Advanced Edition

You can almost imagine Peter Norton's familiar signature being written on your screen as his disk packer does its work. His Speed Disk (SD) program, part of Peter Norton Computing's \$150 *The Norton Utilities—Advanced Edition* (not included in the less expensive Version 4.0), has the Norton signature in more-tangible ways: it's quick, easy, and safe. What it doesn't have are the kinds of options and intelligence found in the main *NU* program that let you explore and edit a disk. Speed Disk reorganizes a disk in one way only.

SD thoroughly packs a disk and does not offer a fast option to defragment files without packing. It thoroughly rearranges



## FACT FILE



**The Norton Utilities—Advanced Edition**  
Peter Norton Computing  
2210 Wilshire Blvd.  
Santa Monica, CA  
90402  
(213) 453-2361  
List Price: \$150; upgrade from earlier versions, \$39.  
**Requires:** 256K RAM, DOS 2.0 or later.  
**In Short:** *The Norton Utilities' Speed Disk* combines speed and safety but it won't organize a disk for the best possible performance, and it has no customizing options. Not copy protected.

CIRCLE 885 ON READER SERVICE CARD

a disk and makes no attempt to leave already unfragmented files in place. It plants all directories at the front of the disk. Then come all the files in the first directory, then all the files in the second, and so on. SD doesn't do any special rearranging of files within each directory.

Although this strategy produces a packed and elegant-looking arrangement, you will soon see a lot of new fragmentation because your data files will be scattered all across the disk. Unless you take the trouble to rearrange all your directories so that the data directories will end up in the right places when SD rearranges them, Norton doesn't give you any way to place your programs at the front of the disk and your frequently written files at the end.

SD begins work by running its own more rigorous counterpart of DOS's CHKDSK, which stops it from acting on a disk if it finds anything out of the ordinary. It then turns on its disk map, which is apparently inspired by California beaches: as the program runs, all the pale and sickly-looking fragmented files gradually turn into bright and healthy-looking defragmented ones. A percent-complete indicator lets you guess how much longer you will have to stare at this restorative process.

We spent a mere 20 minutes watching SD speed through our disk. At the end, the disk was completely packed, but because Norton doesn't mess with hidden files, 11 ordinary files remained fragmented, each of them broken up by one hidden file.



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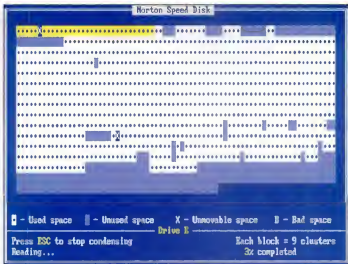
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## HARD DISK DEFRAGMENTERS



Where Mace is dark and moody, the disk map in The Norton Utilities—Advanced Edition is bright and sunny. Norton moves large groups of files at once, rather than working file-by-file.

**PARTLY SMART** Despite its speed, SD takes the time to examine the contents of files before trying to move them. It recognizes the signatures of most copy-protection schemes even when they do not use hidden files. You may be surprised to find that SD's disk map displays some ordi-

with the disk. But DOS 3.3's FASTOPEN command appeared around the same time, so the more recent versions force a reboot when run on a hard disk, unless you press Esc at the final menu. You can safely interrupt file-moving operations at any time by pressing Esc and waiting through the normal delay of a few seconds while SD cleans up the disk and shuts down. The latest versions (dated December 1, 1987, or later) handle partitions larger than 32MB.

SD is smart enough to zip across a disk in less than a minute if the disk has only a small break or two between files. But if it finds more than a few breaks, it insists on uprooting everything on the disk and reorganizing all the files. It takes a lot more time than *PC Tools Deluxe* does in similar circumstances, although SD is much faster than *PC Tools Deluxe* in its initial pass over a heavily fragmented disk. If a disk has been completely packed by another program, SD will rearrange it in the order that SD prefers, but it's smart enough not to repack a disk it packed itself.

Unlike other programs that give you detailed reports of the degree of disk and file fragmentation before they begin, SD only lets you use a command-line switch to ask

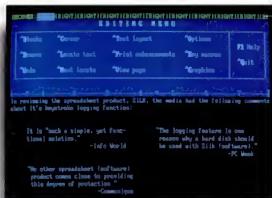
■ **Norton's Speed Disk**  
program takes the time to  
examine the contents of  
files before moving them.

nary-seeming program files as files that it won't move. That's because *Norton* plays safe by skipping over any .EXE file that doesn't have a standard header. Some copy-protection schemes use nonstandard headers, but such headers are also created by some programs used to compress the size of unprotected .EXE files.

The first release of SD, in spring 1987, returned you to DOS when it was finished

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## ■ HARD DISK DEFRAGMENTERS

for a brief report on the percent of fragmentation of any individual file, or on the disk as a whole.

Although *The Norton Utilities* is an impressive package overall, its disk-packing program doesn't have the options or the intelligence to make it stand out among the crowd. But it's fast enough and safe enough to let you run it as often as you like.

### PC Tools Deluxe

Few programs pack as many functions on one floppy disk as does Central Point Software's \$79 *PC Tools Deluxe*. Central Point gives you a file manager, a disk tester, and programs for format recovery and file recovery, plus backup and restore programs, a disk cache, and even a rudimentary word processor. After packing in so much else, the vendor still found room to pack in a disk packer.

*PC Tools Deluxe's* Compress program lets you choose whether to pack the whole disk and unfragment all files or simply unfragment files without packing. A third option, useful for security against snoopers, completely removes all traces of deleted files by packing the disk and filling in all unused clusters with zeroes. Compress normally forces you to bang a lot of keys before it lets you start or stop, but you can run it without intervention from the DOS command line by using a parameter to specify one of the three options.



*PC Tools Deluxe tells you every detail of its operation: the file being moved, the clusters it will now occupy, and the progress of the disk reorganization.*

Compress places all the directories at the head of the disk, but doesn't organize the remaining files in any special order. Unlike packers that read each file in turn and then decide what to do with it, Compress works out its packing strategy before it starts working on the disk itself. The program gains speed by leaving as many unfragmented files in place as possible and inserting the files it does defragment into the space that remains.

**MENU OPTIONS** Every tool in *PC Tools Deluxe* is powerful and well suited to its task, but they all deserve a better screen design and a better use of the keyboard. When you start running Compress you face a series of option menus, but you aren't given a default that you can choose simply by pressing Enter.

One option lets you choose the order in which your files will be listed in your directories when the program finishes. (This does not affect the order in which files will be placed on the disk.) Another option runs a CHKDSK-type function, while still another will test the disk surface for defects and lock out bad clusters. You can also call up a display of all files with a report on the

fragmentation (if any) of each. And you can ask Compress to analyze the organization of the disk and tell you whether compression is necessary at all.

If you skip all these options and go directly to the disk-packing function, Compress automatically analyzes the disk's organization. If your disk is already packed and has the directories at the front the way Compress likes them, it won't waste time by packing the disk again—unlike the *Mace Utilities*, which will run through a packed disk looking for files to rearrange but won't actually move any. Compress recognizes most copy-protection schemes and won't move hidden files.

The program displays a map of its progress with an admirably full report on the name of the file being moved, the clusters involved, the elapsed time, and the amount of work remaining. The only detail missing is the name of the directory that contains the file being moved; after all, distinct files with the same name can appear in different directories on disk.

**SLOW/FAST TIMINGS** Compress is quite fast at packing a disk that has already been packed once, but its initial pass over a



### FACT FILE



**PC Tools Deluxe,**  
Version 3.24  
Central Point Software  
9700 SW Capitol Hwy.,  
#100  
Portland, OR 97219  
(503) 244-5782  
List Price: \$79

**Requires:** 256K RAM, DOS 2.0 or later.  
**In Short:** The disk packer in this superb cornucopia of utilities runs slowly the first time but is smart enough to work fast afterwards—and to refuse to work at all when it isn't needed. One of its options blanks out all deleted files for complete security. Not copy protected.

CIRCLE #112 ON READER SERVICE CARD

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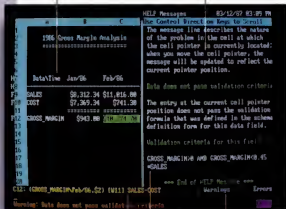
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System Requirements: IBM® PC or compatible with  
PC-DOS® or MS-DOS® 2.0 or higher, with 512KB mem-  
ory; hard disk recommended.

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**CIRCLE 374 ON READER SERVICE CARD**

## ■ HARD DISK DEFRAGMENTERS

highly fragmented disk won't win any speed records. It worked its way slowly through our highly fragmented test disk, taking 1 hour and 11 minutes to finish its work. It left eleven fragmented files, broken in a total of 17 places by the hidden files it left unmoved.

This timing figure shouldn't discourage you from choosing Compress because, after we had revised a few files on disk, later disk-packing passes typically took 2 minutes or less to complete. You can safely interrupt Compress by pressing Esc while it runs, and you won't lose any data if the program is suddenly interrupted by a power failure.

Before you can exit Compress, it asks whether you want to run the *PC Tools Deluxe* program that stores a copy of your file allocation table and root directory for later recovery from an accidental reformat. Although *Mace Utilities*, *Norton*, *Take Charge*, *Disk Optimizer*, and other packages include similar functions, only *PC Tools Deluxe* tries to make certain that you update the stored data immediately after packing a disk. An older copy of this data would be useless or worse after disk packing, so this is an essential precaution. If

■ *PC Tools Deluxe*, with its Compress program, is an amazing bargain in the software world.

you run Compress with a command-line switch that lets you bypass the menu, however, it makes a new copy of this data automatically.

The package includes a "delete-tracking" program that remembers where to find any deleted files so that you can recover them later if their clusters haven't been overwritten by DOS. Of course, you won't be able to recover such files after running Compress.


Central Point Software says that the package's forthcoming Version 4 is completely redesigned and adds a full range of preset disk-packing strategies to Com-


press. Meanwhile, *PC Tools Deluxe* is already one of the amazing bargains of the software world. If you don't need a dedicated disk packer with special options and script files, and if you can wait through an initial run that may seem excessively slow, you'll be satisfied with Compress and all the programs that come with it.

### PolyBoost II

The idea behind the disk packer in Polytron Corp.'s \$80 *PolyBoost II* package of utilities is that you like to stay up to date. Polytron's packing program, called Dskorder, calculates the average date of the files in each directory, then arranges your directories so that the oldest comes first and the most recent comes last. It puts all the files in the directory with the oldest average age near the front of the disk, and all the files in the directory with the youngest average age at the end of the disk. Within each directory, it arranges your files so that the most recent file is at the end.

The normal result is that the directories with your program files stay near the front of the disk, which is where they belong, because you're unlikely to call them into a program and write them again to the disk. This is the result you probably want: it ensures that the area of your disk with pro-

**FACT FILE**

**PolyBoost II**  
Version 2.03  
Polytron Corporation  
1815 NW 169th Pl.,  
#2110  
Beaverton, OR 97006  
(503) 645-1150  
List Price: \$80

Requires: 320K RAM, DOS 2.0 or later.  
In Short: A fast and simple disk packer without options or special safety features. It arranges directories and files by date only. Not copy protected.  
CIRCLE 69 ON READER SERVICE CARD

gram files will stay packed, while the directories with your current data files will be moved toward the end of the disk where the inevitable fragmentation will cause the fewest delays. It also ensures that the program files that you access most often are the files your disk can find most quickly.

This system works less well if your data directories include reference files dating back to 1985 and you just opened a new directory for *WordPerfect 5.0* a few days before running Dskorder. In this case, you'll end up with your data files—the ones that inevitably become fragmented—in the middle of the disk, where they're certain to

CHKDSK Report

The DOS CHKDSK report should follow. If CHKDSK is not found on the current drive an error message may be displayed and the CHKDSK report will not appear.

DSKORDER information screen. Press ESC to abort  
Press any key to continue.

Summary of program operation:  
1. Execute CHKDSK to verify disk is ok. (See above)  
2. Simulate a complete ordering and abort if problems found.  
3. Sort all directories by average date.  
4. Sort all files within each directory by date.  
5. Order disk for optimum access time.

DSKORDER (Ver 2.02) Copyright 1987 POLYTRON Corp.  
Number of clusters is: 8489  
Program status: Reading cluster 18128 Writing cluster 8488

(N)

*PolyBoost II is too busy moving files to bother with an elaborate display. The cluster numbers fly by at a refreshing speed.*



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**CIRCLE 511 ON READER SERVICE CARD**

## ■ HARD DISK DEFRAGMENTERS

leave big holes as soon as you revise them. Unfortunately, *PolyBoost II* doesn't give you any customizing options if you don't like the way it arranges your disk.

**FAST AND UNFORGIVING** Dskorder is fast but dangerous. Polytron's technical support crew acknowledges that if you lose power while the program is running, your disk's FAT will be destroyed. Dskorder runs DOS's CHKDSK before starting and runs through a simulated disk-packing operation to test for problems before it starts the real thing. But once it starts, you have no way to stop it. The program even prevents a press of Ctrl-Alt-Del from having any effect at all. This is clearly designed as a safety measure, but you may feel more comfortable with a program that gives you a chance to change your mind if you suddenly remember that you want to recover a deleted file before the disk packer overwrites it.

Because our test procedure generated files that all used the same date, Dskorder did not have much sorting and calculating to do when it first packed the disk. It rocketed through our test in just 3 minutes, but this result does not reflect real-world conditions in which most files on a disk have widely scattered dates.

When we retested Dskorder, using the same fragmented directory structure but with the files redated to correspond more closely to reality, it took 26 minutes to pack the disk. In both tests, it refused to move hidden files and therefore left 12 files broken. Six of those files were in two fragments, six in three fragments. Once the disk had been packed—and after we modified and fragmented two files—Dskorder needed only 5 minutes to pack the disk a second time.

Polytron doesn't waste processing time on sexy disk maps. All you get is a box telling you which clusters the program is reading and writing. A separate program sorts the listings within a directory (rather than the actual files) and removes entries for deleted files.

Polytron warns that Dskorder should not be used on partitions larger than 32MB. And think twice before using it on anything other than a highly standard hard disk. Whenever I ran it on DOS's VDISK, it chopped up the directory into something

resembling electronic sauerkraut.


The *PolyBoost II* package also includes disk caches, programs to speed up keyboard response and screen writing, a memory tester, and some other small utilities. These programs include options to transform your computer's loud beep into a soft chirp, or to recover and replay DOS commands you used earlier in a session. If you use a standard hard disk and back up often, this package gives you a fast, effective disk packer as well.


### Power Tools

MLI Microsystems supplies only a sparse 24-page manual with its \$50 *Power Tools* package, but the program performs many of the functions of programs weighted down with thick volumes of explanation.

*Power Tools*, which can be run either from the DOS command line or as a pop-up memory-resident powerhouse, includes a file manager, an undeleter, and a diskette formatter, plus the disk packer and file defragmenter that give it a place in this survey.

*Power Tools* won't dazzle you with speed or refinement. It misspells *optimize* on one of its menus, and an obscure bug sometimes causes its disk map to display

**FACT FILE**

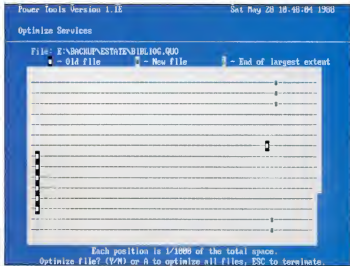
**Power Tools,  
Version 1.2**  
MLI Microsystems  
P.O. Box 825  
Framingham, MA 01701  
(617) 879-2000  
List Price: \$50  
Requires: 320K RAM,  
DOS 2.0 or later.

**In Short:** A toolbox of utilities, including functions for defragmenting files or packing a disk. The menus are confusing, and the disk maps are sometimes mistaken. The disk packer isn't effective on disks with little free space and doesn't have safety features to make it suitable for nonstandard disks. Not copy protected.


CIRCLE 60 ON READER SERVICE CARD

no files at all on a VGA monitor. But the program has some features you won't find elsewhere. You'll have to figure out most of these on your own, because the menus tend to be confusing and there's no on-line help.

You won't get any off-line help from the manual, either. But a bit of experimen-



When *Power Tools* defragments one file at a time (rather than packing the full disk), it displays the file's current location and the place where it intends to put that file.



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CIRCLE 524 ON READER SERVICE CARD

## ■ HARD DISK DEFRAGMENTERS

tation with a carefully backed-up disk will let you find your way around the program's many options.

You can choose to defragment individual files or all the files in the directory or disk, or you can choose to pack and defragment the full disk. If you choose to defragment files or directories, a menu first displays information on all files in the chosen directory, with a report of the number of "extents" (fragments) into which each file is divided. Press Enter to choose the file under the cursor or F1 to choose a group of files (for example, \*.EXE), then press G for Go.

A disk map then appears with symbols that show you where the file is located now and where it would go if you defragmented it. If your disk doesn't have enough room to defragment the file, you can still choose to rearrange it into a different number of fragments, the largest of which appears on-screen with an upside-down question mark at the end. Sometimes the change will increase fragmentation, so a prompt asks you whether you would like to defragment the file.

If you choose to defragment a group of files, or to defragment all the files on your disk without packing, similar disk maps appear in sequence, and you are prompted to decide whether to defragment each file. If you decide to pack the disk, *Power Tools* checks each file in sequence and defragments it without any further prompts. Unfortunately, this option, like the first, often leaves files just as fragmented as they were before. If you interrupt by pressing Esc, the program completes its work on the last file it reached and returns to its main menu.

**LESS THAN DAZZLING** Depending on the state of your disk, *Power Tools* probably won't dazzle you with its disk-packing performance. The disk-packing option took 1 hour and 18 minutes to work through our test disk, and left it with 223 fragmented files—which is only 15 fewer than when it started. Your files, fragmented or not, aren't placed in any special order. Although the manual warns that *Power Tools* treats hidden files as if they were ordinary files, we couldn't persuade the program to defragment a hidden file. It simply (and safely) ignored the command

without returning an error message.

The *Power Tools* disk map sometimes misinterprets a disk's file allocation table and reports that some clusters are locked out when they really are not. The program apparently doesn't attempt to determine whether it knows how to work with the specific type of disk before trying to pack it: *Power Tools* consistently reduced the FAT and directory of DOS's VDISK to electronic confetti.

### SST: The Seek Stopper

Alfred J. Heyman's program *SST: The Seek Stopper* packs your disk—no more, no less. It doesn't give any special privileges to hidden files or copy-protected files. It doesn't try to move directories to the head of the disk. It doesn't come with safety features that let you interrupt it or recover from a power failure without shredding your FAT. It simply does its job and does it completely. And because *SST* is shareware, you can download the program and its manual from any bulletin board (or get it from the disk library of a local user group) and try it out at no charge. If you plan to use the program regularly, you can



## FACT FILE

**SST: The Seek Stopper, Version 2.01**

Alfred J. Heyman

P.O. Box 172101

Memphis, TN 38187

List Price: Shareware (\$10 registration).

Requires: 256K RAM (\$12K for 32MB

hard disk drives); DOS 2.0 or later.

In Short: A simple shareware disk packer with few safety features or options. Not copy protected.

Circle 16 on Reader Service Card

send the author \$10 and become a registered user.

The *SST* manual is short and unpretentious. If you know what you're doing and don't object to the lack of menus, options, and safety features, *SST* can pack a disk as well as its sleek, commercial competition—at a mere fraction of the price. The manual says that *SST* "is intended for computer users who have the ability to quickly back up their disk and who don't have the time to waste for a simple disk optimization."

```

Disk Type Is Fixed Disk.      OEM on Root Sector: 1M 3:3
Bytes Per Sector.....: 512   Sectors Per Disk...: 41735
Sectors Per Cylinder...: 17    Number of Heads...: 4
Reserved Sectors.....: 1      Clusters Per Disk...: 10485
Sects Cluster.....: 4         Unused Clusters...: 1916
Number of FATs.....: 2        Sectors Per FAT...: 41
Bits per FAT entry...: 16      Entries In Root...: 512
Root DIR at Sector...: 83      Data At Sector...: 115
Cluster Bytes.....: 2840      Logical Cylinders: 613.75
Root DIR On Drive K: is 32 sectors long.
    
```

SST Version 2.01  
Copyright 1986  
Alfred J. Heyman

Have you backed  
this disk up?

Did you run  
CHKDSK first?

### Sorting Clusters

- READY TO MAKE PERMANENT CHANGES TO DISK -  
1978 - Clusters Need to be Moved or exchanged.

PRESS - Y - TO CONTINUE, ANY OTHER KEY TO ABORT.

*SST: The Seek Stopper gives you a simple display of disk information. Make sure you really did back up your disk and run CHKDSK, because once you answer yes at the prompt, there's no turning back.*

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- Design CAD 3.0 (NCP) ... 159.
- Design CAD 3D 1.1 (NCP) ... 159.

### Application Techniques ... NCP

- Pizazz Plus ... 75.

### Ashton-Tate ... NCP

- dBASE III Plus 1.1 ... call
- MultiMate Advantage II 1.0 ... 299.
- Master Graphics Pack ... 299

### Best Programs ... NCP

- Label Master 3.1 (mailing label program) ... 29

### Bloc Development ... NCP

- FormTool 2.01 ... 59.

### Borland International ... NCP

- Turbo BASIC 1.1 ... 67
- Turbo C 1.5 ... 67.
- Turbo Pascal 4.0 ... 67.
- Superkey 1.1 ... 67.
- Reflex 1.1 ... 99.
- Eureka 1.0 ... 99.
- Sidekick Plus 1.0 ... 129
- Sprint 1.0 ... 129
- Quattro 1.0 w/SQZPlus 1.0 ... 159.
- Paradox 2.0 (easy-to-use database) ... call

### Broderbund ... CP

- Print Shop ... 39.
- Memory Mate 3.01 (NCP) ... 45.

### Computer Associates ... NCP

- SuperCalc 4.1.1 ... 299.

### Cora International ... NCP

- Corefest 2.0 ... 99

### Crosstalk Communications ... NCP

- Crosstalk XVI 3.61 ... 95.
- Crosstalk MK 4.1.0 ... 124.

### Dac Software ... NCP

- Dac Easy Payroll 3.0 ... 59
- Dac Easy Light 1.0 ... 45
- Dac Easy Accounting 3.0 ... 59
- Dac Easy Bonus Pak 3.0 ... 115.

### Digital Research ... NCP

- Gem Draw Plus 2.01 ... 189

### Gem Desktop Publisher 1.1

- 5th Generation ... NCP ... 259

### Fastback Plus 1.01

- ... 99

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Testdrive (for IBM PC/XT/AT/PS/2 and compatibles) ... \$22.

### Fox Software ... NCP

- Foxbase Plus 2.1 ... 209.

### Funk Software ... NCP

- Sideways 3.21 (creates wide printouts) ... 42.

- Worksheet Utilities 1.0 (1-2-3 utilities) ... 59.

### General Information ... NCP

- Hot Line Two ... 57.

### Generic Software ... NCP

- Generic CADD Level 3 1.01 ... 109.

- Dot Plot 3.0 ... 35.

- Drafting Enhancements ... 35

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- PC LOGO 2.0 ... 89.

### Hayes ... NCP

- Smartcom II 3.0 ... 89

### Hilgraves Software ... NCP

- HyperACCESS 3.3 ... 89

### Individual Software ... NCP

- Typing Instructor Encore ... 26

- Professor DOS (with Smartguide) ... 33.

### Intuit ... NCP

- Quicken 2.0 ... 35

### Jewell Software ... NCP

- Javelin Plus 2.01 ... 249.

### Lotus ... NCP

- 1-2-3 2.01 (now not copy-protected) ... call

- Symphony ... call

### MacroPac International ... NCP

- 101 Macros for ...

- 1-2-3 dBASE III Plus WordPerfect ... each 42.

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- Managing Your Money 4.0 ... 125.

### Meridian Technology ... NCP

- CarbonCopy Plus 5.0 ... 115

### Micro Logic ... NCP

- Tornado 1.8 ... \$55

### Microlytics ... NCP

- Goler 1.0 (text retrieval system) ... 45.

- Wordfinder 4.0 (electronic thesaurus) ... 35.

### MicroPro ... NCP

- WordStar Professional Release 5 ... 259.

- WordStar 2000 Plus Rel. 3 (Personal Ed.) ... 259.

### Microsim ... NCP

- R-BASE for DOS (version 2.1) ... 449.

### Microsoft ... NCP

- Learning DOS (for any DOS version) ... 35.

- Windows 286 2.1 ... 69.

- Works 1.05 ... 99

- Windows 386 2.1 ... 129

- Bookshelf 1.0 w/Amdisk Laser Drive ... 799.

- Word 4.0 ... 209.

- Excel 2.0 (requires 80286/80386 CPU) ... 319.

- Quick BASIC 4.0 ... 69

- Quick C 1.01 ... 69

- Macro Assembler 5.0 ... 99.

- C Compiler 5.1 ... 299

### Migent ... NCP

- Ability Plus 1.0 ... 149.

### Monogram ... NCP

- Dollars & Sense 3.1 ... 105.

### Nantucket Software ... NCP

- Clipper (Summer '87, d83 Plus compiler) ... 459.

### New England Software ... NCP

- Graph-in-the-Box Release 2 ... 75.

### Nolo Press ... NCP

- WillMaker 3.0 ... 35.

### North Edge Software ... NCP

- Timeslips III 3.3 ... 119

### Owl International ... NCP

- Guide 2.0 ... 143.

### Paperback Software ... NCP

- VP-Planner Plus 2.0 ... 145.

- VP-Expert 2.0 (expert system) ... 145.

### Paul Mace ... NCP

- H/est-H/Format 2.0 (hard-disk tools) ... 49.

- Mace Utilities 4.1 (DOS utilities) ... 55.

### Personal Computer Support Group ... NCP

- Lightning 4.80 ... 57.

- Lucid 3-D 1.22 ... 89

### Perasonics ... NCP

- SmartNotes 2.0 ... 49

- SeeMore 1.0 ... 49.

- SeeBASE 1.1 ... 119

### Peter Norton ... NCP

- Norton Utilities 4.0 ... 55

- Advanced Utilities 1.0 ... 79

- Dan Brinkin's Demo Program 2 ... 99

### Quarterdeck ... NCP

- DESQView 2.01 (operating environment) ... 79

- Expanded Memory Manager 4.1 ... 39.

### Revolution Software ... NCP

- Cruise Control 3.02 ... 39

### Simon & Schuster ... NCP

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- Professional Thesaurus 1.0 ... 78.

- New World Writer II 1.0 ... 89

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<b>True BASIC, Inc. ... NCP</b>	
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□ Algebra (includes both I & II)	32.
<b>Vericomp ... NCP</b>	
□ SoftBytes 2.0	35.
□ SoftBytes 386 2.53	49.
<b>WordPerfect Corp. ... NCP</b>	
□ WordPerfect Library 2.0	69.
□ WordPerfect 5.0	255.
□ DataPerfect 2.0	299.
<b>Xerox ... NCP</b>	
□ Ventura Publisher 1.1	549.

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<b>Accolade ... CP (reqs. graphics brd.)</b>	
□ Hardball (baseball simulation)	11.
□ Testdrive (driving simulation)	special
<b>Electronic Arts ... CP (reqs. graphics brd.)</b>	
□ Chuck Yeager's Flight Simulator	32.
<b>Infocom ... NCP</b>	
□ Zork Trilogy	33.
<b>Microprose ... CP</b>	
□ F-15 Strike Eagle (requires CGA)	22.
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### Parlor Software ... CP

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### Sierra On-Line ... CP

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□ Space Quest II (requires CGA or EGA) 33.

□ King's Quest III (requires CGA or EGA) 33.

□ Police Quest (requires CGA or EGA) 33.

### Sphere, Inc. ... NCP

□ Tetris (addicting mind teaser) 24.

□ Falcon (F-16 simulation, reqs. graphics brd.) 32.

### Sublogic ... NCP

□ Jet 2.1 (requires EGA or CGA) 33.

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□ NFL Challenge 69.

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### AST Research ... 2 years

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### CompuCase ... 2 years

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3-Position switch box 39.

### Cuesta ... 1 year

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### Curtis ... lifetime

### ACCESSORIES

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Printer Stand PS-1 16.

Universal System Stand SS-3 25.

DS-1 Switch Box (controls 2 printers) 33.

### CABLES

Smartmodem-to-PC Cable (9 feet) 17.

Printer-to-IBM cable (9 feet) 17.

### SURGE SUPPRESSORS

Safesnap SP-1 (6 outlets; 1 year wrty) 21.

Diamond SP-1 (6 outlets) 32.

Ruby (6 outlets; EMI/RFI filtered; 6 ft cord) 59.

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### Everex ... 1 year

1200 Baud Internal Modem 79.

2400 Baud Internal Modem 149.

### 5th Generation ... 6 months

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Logical Connection 512k 529.

### Hayes ... 2 years

Smartmodem 1200 299.

Smartmodem 1200B (with Smartcom II) 299.

Smartmodem 1200B (no software) 265.

Smartmodem 2400 449.

Smartmodem 2400B (with Smartcom II) 449.

### Hercules ... 2 years

Graphics Card Plus 189.

Network Card Plus (with TOPS DOS) 349.

### Intel ... 5 years

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## ■ HARD DISK DEFRAGMENTERS

**SMART AND SPEEDY** That was written in 1986, but SST is still among the fastest disk packers. The program took only 18 minutes to pack our test disk. It moved hidden files without hesitating and was therefore one of the programs that left the disk with no fragmented files at all. Later passes are only a little faster if there is a gap near the front of the disk, but a lot faster if the gaps and fragments are near the end. SST is smart enough not to repack a disk that is already packed.

SST starts by making a CHKDSK-like survey of your disk organization. If it detects no problems, it gives you one chance to confirm that you want to continue, and

■ **SST does all its work in memory and doesn't update FATs or directories until it's finished.**

then there's no stopping it. You cannot interrupt it by pressing Esc or Ctrl-Break, and if you use brute force to stop it by pressing Ctrl-Alt-Del or by turning off the machine, your data will disappear into the great bit-bucket in the sky. Most other disk packers guard against accidental data loss by keeping a spare copy of a cluster on-disk while transferring another copy from one part of the disk to another. SST does all its work in memory and doesn't update the file allocation tables or directories until it's finished.

You can run SST in a test mode that will run through its full procedures without writing any data to the disk. You can reboot during a test run without causing any damage, but make certain that you really are in a test run before you try it. The only other option lets you tell the program to move directory entries for erased files to the end of the directory listing without actually moving the files to different locations on the disk. SST's screen display gives you technical information about the disk and reports the number of clusters it still needs to move.

SST has one safety feature that belongs

in some of the commercial competition: it won't even attempt to reorganize a non-standard disk. When I tried to run it on DOS's VDISK, it resolutely refused to do anything. Two of the more-expensive packages demolished VDISK's FAT and directory. Shareware sometimes knows best.

### Take Charge

If Departmental Technologies packed any more functions into its \$99.99 *Take Charge* disk organizer and utility toolbox, the vendor would have to ship it on a hard disk.

The current version of the program ships on three disks. Besides combining most of the functions of *SideKick* and *The Norton Utilities*, it throws in a communications module so that you can tell your friends about all its features. If you run *Take Charge* as a memory-resident program, it uses a kernel of only 23K RAM and swaps its dozens of functions from disk only when you need them. You may not need a memory-resident disk packer, but if you do, *Take Charge* has one for you at the touch of a hotkey.

*Take Charge*, written by Shane and



## FACT FILE



**Take Charge,**  
Version 1.1Z  
Departmental  
Technologies Inc.  
131 Washington St.  
Lodi, NJ 07644  
(201) 473-2400  
List Price: \$99.99

Requires: 256K RAM, hard disk or RAM-disk, DOS 2.0 or later.

In Short: The disk packer included in this cornucopia of features isn't as fast or as safe as the competition, but it does the job thoroughly and effectively. Not copy protected.  
CIRCLE 66 ON READER SERVICE CARD

Sandi Stump, isn't an elegant or thoroughly polished product. Users with monochrome systems will be disconcerted by a menu reporting that the item you selected is highlighted in red. And the down-home style of some of the messages seems mildly startling in the slick world of today's software. But the package gets the job done. In fact, it gets about 50 jobs done.

You can run *Take Charge*'s disk packer from the DOS command line or from the



Are formerly fragmented clusters glad to be back together again? Take Charge displays defragmented files as smiling faces.

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September 29, 1987, PC Magazine

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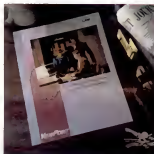
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CIRCLE 508 ON READER SERVICE CARD

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## ■ HARD DISK DEFRAGMENTERS

Disk Services menu of the pop-up kernel. Either way, the program first asks whether you've removed all copy-protected software. You can lie and say yes, but this isn't a good idea. *Take Charge* will pack and move all your files, whether or not they're marked with hidden or system or read-only attributes. And it doesn't check your files to see if they belong to any common copy-protection schemes.

**SLOW AND STEADY** *Take Charge* is slow and sure when packing a disk. After it ran DOS's CHKDSK, *Take Charge* took 42 minutes to pack our test disk—but packed it solidly. Because it moves hidden files, this was one of the programs that left no fragmented files at all. We chose the fastest packing option, which arranges all files in the sequence found in the directories. Later runs were considerably faster. If you have EMS memory, you can further speed *Take Charge*'s operations by using a command-line parameter that specifies expanded memory as a data-swapping area.

Any one of four file-arrangement options on the opening menu would have taken longer than a sequential arrangement but ultimately would have improved disk performance. Each of these options places read-only files and directories at the head of the disk, then follows them with all other files in the order in which they are found in the directories, or in date order (with the most recent file last), or in order of size, or in an arrangement that has all program files followed by all other files in date order.

*Take Charge* displays a map of its progress that shows defragmented files as happy faces and lists the number of files processed. When the program is through packing your disk, it displays a message telling you that if the directory "looks like garbage" you should run CHKDSK to clear the DOS buffers.

You can safely interrupt disk packing at any point by pressing Esc, but the manual warns that if you reboot or pull the plug, you may destroy the file allocation table. Many competing programs leave your disk intact after a reboot or power loss; you should always have a set of backups before running *Take Charge*'s disk packer.


*Take Charge* helps you recover from other disasters also. It includes a disk test program and programs for recovering

from an accidental reformat or file deletions. When you pay so little for so many functions, you won't get all the features you find in separate programs dedicated to one function alone. But for most purposes, *Take Charge* gives you all the features you need.

### VOPt

Depending on the state of your disk and what you want from a defragmenter, Golden Bow Systems' \$49.95 *VOPt* will seem like either a daydream or a nightmare. *VOPt* is the fastest of the defragmenters, and it has the most colorful and entertaining screen display, but it does far less than the competition. In many—perhaps most—circumstances, *VOPt*'s less will be more than enough. But if it isn't enough for your circumstances, prepare for a frustrating experience.

The README file on the *VOPt* disk explains that the program avoids any attempts to move a file that will result in "no real payoff." In practice, this means that *VOPt* doesn't try very hard to defragment large files on crowded disks. And if you have a lot of large fragmented files near the end of your disk, *VOPt* makes no serious



## FACT FILE

**VOPt, Version 2.20**  
Golden Bow Systems  
2870 Fifth Ave., #201  
San Diego, CA 92103  
(619) 296-9349  
List Price: \$49.95  
Requires: 512K RAM,  
DOS 2.0 or later

**In Short:** This program is very fast but not very effective if your disk has a lot of large fragmented files. It is good for quick clean-ups of disks already in good order, and it includes the most entertaining of all progress displays. Not copy protected.

DISKETTES ON READER SERVICE CARD

attempt to pack the disk at all. The README file adds that "you may, therefore, notice a few empty clusters embedded in the 'used' disk area after running *VOPt*."

Our test results presented a different picture. Unlike all the other defragmenters, *VOPt* rushed from the starting gate without asking questions or offering options, and it raced across our disk in only 9 minutes. It began by listing the hidden files that it

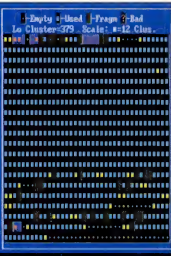
Vopt Version 2.15 serial no. 708257  
Copyright (C) Golden Bow Systems 1987

```
Volume 20MegPlusHD
Hidden files not moved: TAPE_DTE.DAT
Hidden files not moved: OLDBACK.N_U
Hidden files not moved: BACKUP.N_U


41628 sectors total disk space
 4 sectors in 2 hidden files
128 sectors in 30 directories
33820 sectors in 634 user files
7668 sectors available on disk

 5 empty files
539 clusters in 18 fragmented files
9045 is the highest used cluster
383 is the lowest empty cluster
556 free clusters in the used space
```

Files Moved 2



*VOPt* has the most colorful display of all. What you can't see in the screen shot is the way the colored squares dance around the screen as data clusters jump around the disk.



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CIRCLE 330 ON READER SERVICE CARD

## ■ HARD DISK DEFRAGMENTERS

would not try to move, then offered a fast-moving and fascinating light show on its disk map as fragmented files came together again and raced around the disk.

But in every measure except raw speed, *VOpt* produced unimpressive results. It didn't bother to unfragment 56 files, and some of the larger ones were still scattered into as many as 25 pieces. It left a total of 818 breaks and gaps on the disk. Running the program a few more times didn't bring any significant improvement in the condition of those large, fragmented files.

On the other hand, if your disk has already been defragged and packed by some other program, or if it isn't very fragmented in the first place, or if it has a lot of free space for moving files around, *VOpt* can tidy it up in a minute or two. You don't get the major overhaul you get from other programs, but you don't always want one, and you can use *VOpt* as a quick supplement to more-powerful programs. It's one defrag-

ger that you might consider using in your AUTOEXEC.BAT file every morning—although *FastTrax* is just as fast when merely defragging files. And you can speed it up slightly by using a command-line switch to turn off the disk map.

**SAFETY SECOND** *VOpt* has a mixed personality in its approach to safety. You can't interrupt *VOpt* once it starts moving. Esc and Ctrl-Break have no effect. This can be dangerous if you run it by mistake on a drive where you might want to recover a deleted file. But unlike much of the competition, *VOpt* forces a reboot if it detects FASTOPEN in memory (otherwise, FASTOPEN would force DOS to look for each program where it was before you ran the defragger). Thus *VOpt* prevents you from getting any terrifying "File not found" messages when you try programs that are really safe on your disk.

*VOpt* doesn't verify its data transfers in

any way. You can turn on DOS's VERIFY function before running *VOpt*, but you won't gain much by doing so.

*VOpt* includes a CHKDSK-style func-

---

■ With *VOpt* you don't get a major overhaul, but you don't always want one. It's a supplement to more-powerful programs.

---

tion that will eliminate any lost cluster chains that may have been left on the disk when you failed to exit a program correctly. And if it bumps into clusters that can no longer store data, it locks them out of the

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CIRCLE 209 ON READER SERVICE CARD

**PC** EDITOR'S  
CHOICE

• FastTrax

*FastTrax has more brains and more power than any other packer/defragger. Priced at \$49.95, it does more than any other program to arrange your files so that your disk spends the least possible time and effort to find them. Using a technique that most other packages don't offer, the program analyzes files so that each file resides on only one cylinder. It can also help minimize the inevitable fragmentation that occurs after the program is run. It's very fast the first time you run it, lightning-fast afterwards.*

*If the thought of buying a separate disk-packing program seems extravagant, get a program that is packaged with other utilities. You won't be unhappy with the ones in The Norton Utilities—Advanced Edition, PC Tools Deluxe, or the Mace Utilities. Norton is fastest on an initial disk-packing run through a disk, but PC Tools and Mace are smart enough to zip through later passes; both include an option for quick file-defragmenting without packing the whole disk. All are as safe as disk packers can get.*

file allocation table. Both of these jobs are performed more thoroughly by two other programs that are included in the *VOPi* package: a separate disk-testing program and a more informative replacement for DOS's CHKDSK.

Still other goodies tumble out of the *VOPi* package. You get some simple programs to test the speed of your system and hard disk, plus programs to check floppy-disk-drive performance, speed up print-screen operations, report on the presence of memory-resident programs, find files on hard disks, and set screen colors. A fast, full-screen disk-mapping program displays file fragmentation in the same style as *VOPi*'s half-screen map. You can use this program to confirm that *VOPi* left your disk with more fragmented files than you ever expected when you bought it. ☐

Edward Mendelson is a contributing editor of PC Magazine.

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# LEVERAGING RAM with LIM 4.0

Face it. Since you got your PC those untold years ago, your problems have gotten bigger, not smaller. Not that your PC causes your headaches—rather, the machine has made you so much more efficient that you're tackling challenges of increasing difficulty.

Your PC, however, has not kept pace. No matter whether you've just invested in the most powerful PS/2 or are still using your original PC-XT, most of the applications you want to run still must fit within the confines dictated by DOS—640K of memory.

Those widely touted ultimate solutions won't help. The latest 80386 operating environments only let you run more, not bigger, applications. The promises made for OS/2 won't solve your problems of the present either. More a religion than an operating system, OS/2 still awaits the coming of a new world and a new order.

On the outskirts of DOS, however, lies an answer. In August 1987, a new expanded memory specification (EMS) was announced, replacing the original EMS 3.2 that dated back to August 1985.

Called either EMS 4.0 or LIM

*The nine LIM  
4.0-compatible memory  
boards evaluated  
by PC Labs  
will let you break  
DOS's 640K  
barrier  
today as well as  
gear up  
for the move  
to OS/2.*

4.0 (after Lotus, Intel, and Microsoft, the progenitors of the original version), the new memory-handling technique offers a double-barreled combination of virtues. First, it gives you a huge memory area, one that stretches 32MB wide—twice the direct addressing range of the 80286 microprocessor. Unlike memory handling under EMS 3.2, both program code and data can use the expanded memory area under the new version. Second, LIM 4.0 is already supported by dozens of applications because it's completely compatible with both EMS 3.2 and the enhanced EMS that was originally promoted by AST Research, Quadram, and Ashton-Tate. That means you can put LIM 4.0 products to work today.

There's a catch, of course. Making LIM 4.0 work requires LIM 4.0-compatible hardware. If you have a PC, an XT, or an AT, you'll probably need a new memory board even if you're already equipped for EMS 3.2. Because LIM 4.0 uses new registers and different memory-handling techniques, ordinary EMS 3.2 memory products can't bring many of the advanced features of LIM 4.0 to life.

## ■ LIM 4.0 BOARDS

On the other hand, EEMS memory boards come close enough to meeting the demands of LIM 4.0 that you can add the power of the new memory standard to many of them just with new driver software.

The situation with Micro Channel PS/2s is even more promising. By virtue of their built-in memory-banking capabilities, these machines can be upgraded to LIM 4.0 with software (provided you have enough memory to begin with). For instance, the six memory-expansion boards for Micro Channel PS/2s previously reviewed by *PC Magazine* ("Beyond Native Memory: Add-in Boards for PS/2 Models 50 and 60," March 15, 1988)—AST Research's Advantage/2, Cumulus Corp.'s CuRAM, IDEAssociates' IDEAmix/MC, Quadram Corp.'s QuadMEG PS/Q, STB Systems' RapidRAM 2, and Tecmar's Mi-

croRAM—all can be made compatible with LIM 4.0 by adding new software drivers. Current versions of these products ship with LIM 4.0 drivers.

All expanded memory products—EMS 3.2, EEMS, and LIM 4.0 alike—have been developed for the same underlying reason: the 8088 and 8086 microprocessors used in PCs and XT's are, compared with the latest chip designs, severely constrained in their memory-addressing abilities. Because these chips are endowed with but 20 address lines, they can directly manipulate only 1MB of memory (that is, two to the twentieth power addresses). Without a clean room, precision tools, and more patience than the most skilled surgeon, it's impossible to graft additional address lines onto a microprocessor.

Expanded memory simply sidesteps the address-line limitation. Using techniques

termed *paging* and *bank switching*, it makes each existing address line handle more than a single byte of memory.

In bank switching, memory is divided into several banks, each of which is set up as if it were the normal memory assigned to the microprocessor. An electronic switch connects one of the banks at a time to the address lines of the microprocessor. The microprocessor can read and change only the bytes in the currently connected bank. That is, each bank is a universe unto itself, completely independent of the rest, and can occupy the entire address range of the microprocessor.

Paging, a variation on the bank-switching technique, is used for all three types of expanded memory. Instead of connecting and disconnecting the memory spreading across the entire address range of the microprocessor, paging moves smaller blocks—a mere 16K in each under the expanded memory specifications—into and out of the microprocessor's memory realm.

Logistics are an important part of all expanded memory specifications. Two quantities must be defined to make the system work across all product lines. Some area within the microprocessor's address range must be given over as a paging area, where the memory swaps can be made. In addition, some means of controlling the switch must be standardized.

Under EMS 3.2, the normal 640K base-memory area used by DOS is deemed off-limits for paging because in most PCs memory is directly connected to the microprocessor's address lines and cannot be switched around. Moreover, moving this memory could shock programs that might suddenly find a block of their code switched to never-never land. In addition, DOS memory is in short supply as it is; prying more bytes from its grasp would be counterproductive, particularly for people who try to load a dozen terminate-and-stay-resident utilities.

For all of these reasons, the original EMS 3.2 requisitioned an area above DOS memory but within the megabyte address range of the 8088 for its paging. Leafing through this stretch can be treacherous, however, because IBM reserved all memory between 640K and 1024K for specific purposes—video memory and BIOS, hard



### The LIM 4.0 Memory Advantage: Bigger Is Better

These maps show the difference in the amount of mappable memory available under the EMS 3.2 specification and the LIM 4.0 specification. EMS 3.2 supplied 8MB of memory beyond the 640K limit, while LIM 4.0 supplies up to 32MB of memory above 640K. Both EMS 3.2 and LIM 4.0 call for addressing memory in page frames of 64K. As the tinted areas indicate, LIM 4.0 offers the ability to map any application that resides in memory from 0K

to 884K, whereas EMS 3.2 offered only a 64K address range for expanded memory. (In both cases, areas above 884K are reserved for ROM.) As a result, video driver routines, device drivers, network devices, and even LIM 4.0's Expanded Memory Manager drivers can take advantage of this enlarged addressing range. As a practical matter, though, you will probably not want to use the areas already reserved for display ROM, COMMAND.COM, and the DOS work/system area.

LIM EMS 4.0 Mappable Memory

	Address	Segment
ROM BIOS	1024K	10000
Extra ROM	960K	F000
64K LIM EMS	884K	D000
EGA ROM	784K	C400
EGA ROM	768K	C000
Unused	752K	ec00
CGA	736K	B800
Unused	720K	B400
Monochrome	704K	a000
EGA and VGA	640K	A000
Swappable	256K	4000
Conventional memory	0K	000

LIM EMS 3.2 Mappable Memory

	Address	Segment
ROM BIOS	1024K	10000
Extra ROM	960K	F000
64K LIM EMS	884K	D000
EGA ROM	784K	C400
EGA ROM	768K	C000
Unused	752K	ec00
CGA	736K	B800
Unused	720K	B400
Monochrome	704K	a000
EGA and VGA	640K	A000
Swappable	256K	4000
Conventional memory	0K	000

disk, and network ROM. Nevertheless, in most systems large blocks in this addressing range are unused. EMS 3.2 simply took over a 64K range for use in paging.

To control the paging into and out of this memory range, all the expanded memory specifications pass instructions through one of your system's I/O ports. Your computer's microprocessor need only send the page number it wants to the port controlled by the EMS board, and the appropriate page is switched into range. Programs that use EMS must, of course, know the correct port number to make use of expanded memory.

In addition to these facilities, the expanded memory specifications also provide your system with an extended set of commands for streamlining the use of the extra memory. The instructions are packaged as an expanded memory driver, software that's loaded into your system through its CONFIG.SYS file.

The more complex EEMS system allows greater versatility by moving 16K pages—up to 64—in and out of the DOS area as well as the IBM reserved area. Control software that uses EEMS (for instance, Quarterdeck Software's *DESQview*) is charged with the responsibility of making sure programs have all their code available when they need it.

On pre-PS/2 hardware, giving EEMS control over DOS memory requires finding an unused memory area within DOS's 640K limit that can be used for paging. That means either not installing the full 640K quota in your PC or depopulating (prying chips off) your system board, which may waste memory that you've paid for. While the specification allows access to the full 1MB addressing range of 8088 and 8086 microprocessors, in practice EEMS cannot manipulate all DOS memory in systems with hard-wired memory allocation because some RAM must remain conventionally connected to the microprocessor to allow it to boot up properly. According to most vendors of EEMS products, keeping 256K of conventional DOS memory allows optimal operation. (Note that EEMS is a superset of EMS 3.2 and will work exactly like it if no DOS-addressable memory is available to it.)

By moving to the DOS area and manipulating larger memory blocks, and pro-

## LIM-ULATORS: THE NEXT BEST THING TO HARDWARE

*You can let your PC take advantage of expanded memory without buying an expensive LIM 4.0 board.*

**L**IM-ulators are software-only products that emulate the operation of expanded memory boards. Simply by adding the appropriate entry to your system's CONFIG.SYS file and LIM-ulator software, you can add expanded memory to your system, drawn either from the extended addressing area or from the hard disk using virtual memory techniques. Five of these products, compatible with Version 3.2 of the expanded memory specification, were reviewed by Charles Petzold in "Emulating Expanded Memory: Five Software Alternatives" in the March 31, 1987, issue of *PC Magazine*.

The complete LIM 4.0 specification cannot be simulated, however. Both the developers of LIM 4.0 (in particular, Lotus) and the creators of LIM-ulators agree that some of the hardware features of the new specification cannot be duplicated through software alone.

The chief impediment arises in an esoteric area. "EMS 3.2 left ambiguous

whether the same page can be mapped at two different addresses," explained Locke Versar, principal of Fort's Software, publisher of *V-EMM*, a software-only LIM 4.0 emulator. "Version 4.0 defines how such a mapping must work in a way that is totally impossible to do only with software." Currently, few programs do such double-mapping, so most LIM 4.0 programs will work with software-only emulators written to simulate all other aspects of the specification.

At the time of this writing, only Fort's Software offered a software-only LIM 4.0 emulator. Current versions of *V-EMM* include individual drivers that follow the EMS 3.2 and LIM 4.0 specifications. Because of the complexity of the new specification and its added memory requirements, the company recommends using the EMS 3.2 emulator whenever possible; the LIM 4.0 emulator only when absolutely necessary.

—Winn L. Rosch

viding additional software support, EEMS added an important ability to ordinary EMS: programs could run their code in the expanded memory area.

LIM 4.0 extrapolates further on EEMS, making both old EMS 3.2 and EEMS subsets of itself. It takes advantage of all the code-running and DOS-switching abilities of EEMS and adds the power to handle greater memory and greater support of multitasking. It allows programs to be written that can manage multitasking themselves instead of requiring the use of special operating environments (for instance, *Microsoft Windows* or *DESQview*). Programmers benefit from a doubling of the number of functions built into the specification that make taking full advantage of the expanded memory easier.

While EMS 3.2 allowed the addressing

of no more than 2MB per expansion slot, LIM 4.0 is virtually unlimited. Its quadrupled capacity (32MB versus the 8MB of EMS 3.2) even puts older 8088 microprocessors on a par with the abilities of the 80286 and 80386SX chips. In fact, the huge addressing range of LIM 4.0 also puts it way ahead of OS/2, which is currently restrained by the 16MB limit of the 80286 chip. Only the 80386 can handle more RAM, and using it effectively requires exotic software indeed.

**THE OS/2 QUESTION** Expanded memory and OS/2 mix about as well as oil and water. Although the two techniques for putting more memory at the beck and call of your programs are not mutually exclusive, the results of combining them are unlikely to be either pleasant or desirable.

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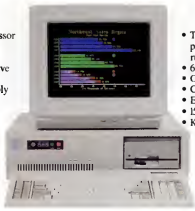
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## ■ LIM 4.0 BOARDS



### Performance Tests: LIM 4.0 Boards

**P**C Labs tested six PC- and AT-compatible LIM 4.0 boards using an 8-MHz IBM PC AT with a 30MB hard disk and three Micro Channel PS/2-compatible boards using a 10-MHz IBM PS/2 Model 60 with 1MB of system memory. Test results were normalized against Intel's Above Board PS/286 for the PC- and AT-class boards, and Intel's Above Board 2 for the PS/2-compatible boards.

The great difference in performance between the fastest and slowest boards was mainly due to the presence of extra hardware registers. If extra registers are not present, they must be emulated by the software. This may slow the processing of certain functions. In some cases, however, especially efficient LIM 4.0 software may make up for the absence of extra hardware registers.

The fastest PC- and AT-compatible LIM 4.0 boards were AST's Advantage Premium and Rampage 286, Micron Technology's Micron Memory Board, and Newer Technology's Concentration board. Of these four, the AST boards and the Concentration board came equipped with extra hardware registers. The Micron Memory Board

turned in very fast times without extra registers because its software takes advantage of whole word moves, not just byte moves.

Among the PS/2-compatible LIM 4.0 boards, Orchid's RamQuest II and RamQuest Extra were considerably faster than Intel's Above Board 2. The Orchid boards employ TRAM, or translation RAM, a Micro Channel architecture function that allows quick memory swaps with low overhead.

Conventional software memory moves require that a string move function be performed to swap memory addresses. With TRAM, as implemented by Orchid, a dynamic swap may be made with very little overhead, resulting in the kind of speed that these boards yielded in our tests.

We installed the boards using the default mode for most and selecting zero wait states when possible. Note that running a board at zero wait states depends upon your computer's clock speed and the memory chip speed of the board. This is explained fully in the documentation that accompanies each board.

#### Advantage Premium



Chip with alternate hardware registers

Alternate hardware registers, a major speed-enhancer, are implemented on AST's Advantage Premium board with this chip. Of the boards tested, only the AST boards and Newer Technology's Concentration board were equipped with extra registers to handle memory swapping and multitasking.

#### PC- and AT-Bus Compatible

Performance Times (Times given in seconds)	Move Test 128K-byte records			54-byte records		
	Expanded to conventional	Conventional to conventional	Conventional to expanded	Expanded to conventional	Conventional to conventional	Conventional to expanded
Bocaram AT	4.45	4.43	4.45	4.52	6.07	5.32
Above Board PS/286	4.45	4.45	4.45	4.45	5.89	5.30
Concentration	0.32	0.19	0.32	0.40	2.28	1.09
Advantage Premium	0.27	0.10	0.25	0.43	2.14	1.77
Rampage 286	0.25	0.10	0.27	0.40	2.14	1.79
Micron Memory Board	0.10	0.05	0.05	0.10	2.63	2.41

#### Micro Channel PS/2 Compatible

Above Board 2	2.96	3.02	3.00	2.98	4.15	3.57
RamQuest II	0.08	0.05	0.07	0.10	1.50	1.31
RamQuest Extra	0.07	0.06	0.07	0.08	1.55	1.33

The LIM 4.0 specification is implemented through a combination of hardware, in the form of an expanded memory adapter board, and software, in the form of the EMM or Expanded Memory Manager. The EMM is a DOS device driver that controls and manages access to and allocation of expanded memory. It supplies a number of services that an application can call upon in order to use expanded memory.

One of the services that the EMM offers is the Move Memory Region function. By requesting that this service be performed by the EMM, an application can use this function to move a block of data without changing the current memory map. The EMM then takes over and does the actual work of moving the block of data.

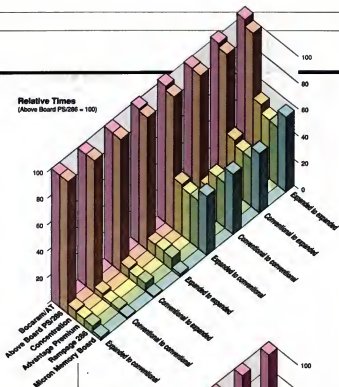
The PC Labs Move Test measures how long it takes a board's implementation of the EMM to move a 256K block of data using the Move Memory Region function. The test is performed twice, once using small records and once using large records. The small-record test uses 64-byte records and indicates the amount of function call overhead incurred, since the 64-byte move is performed 4,000 times in order to move the entire 256K block.

The large-record test uses 128K records and thus is a measure of the speed at which the EMM can move large multisection blocks of data. In this case, less overhead is incurred because the 256K block is moved in two pieces.

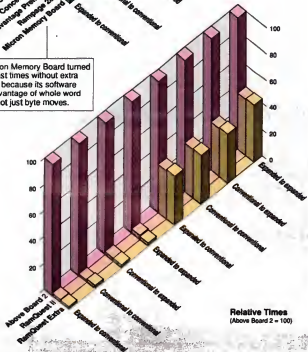
The data is moved from expanded memory to conventional memory, conventional to conventional, conventional to expanded, and expanded to expanded memory. For 64-byte records, moves from conventional to conventional should be the fastest because the EMM does not have to save the current mapping context (conventional memory does not need to be mapped as expanded does). Conversely, 54-byte record moves from expanded to expanded should take the longest, since the current mapping context must be saved and restored. This difference is less apparent for 128K records, which are moved only twice.

Expanded memory adapters that are equipped with extra hardware registers have a performance advantage here because the mapping context can be saved and restored from these registers.

**Relative Times**  
(Above Board PS/286 = 100)



The Micron Memory Board turned in very fast times without extra registers because its software takes advantage of whole word moves, not just byte moves.



**Relative Times**  
(Above Board 2 = 100)

Moreover, the pairing will probably be futile. Both require software that's written particularly to their individual standards. Since either standard brings your PC all the power that you're likely to need, brewing together two levels of complication for no additional benefit makes little sense. Either standard lets you break the DOS 640K addressing barrier. Each, however, offers its own individual benefits.

Expanded memory gives you the advantage of having a base of software that's available now. All existing LIM 3.2 and EEMS programs will run under the LIM 4.0 standard. In addition, LIM 4.0 will enable big applications to run on 8088- and 8086-based computers, while OS/2 requires at least an 80286 microprocessor. LIM 4.0 also can add its power to other PCs for which compatible versions of OS/2 are not available. (OS/2 is very hardware-specific, and nearly every manufacturer's computers require their own version of the operating system.) In other words, today LIM 4.0 allows you a wider selection of programs and platforms.

While OS/2 does let you run existing DOS programs, it forces you to execute them in its performance-robbing compatibility box. While you can get by doing that, you won't want to use the compatibility box for running your most important, everyday applications.

The real role of OS/2, as writers have been saying for the past year and a half, lies in the future. Someday—perhaps soon—you may run into the perfect program, one that does everything that you've only dreamed was possible before, including multitasking and handling data elements of multiple megabytes, and that takes advantage of all the programmers' hooks, lines, and sinkers built into OS/2. When you find that program, you'll finally be forced to use OS/2.

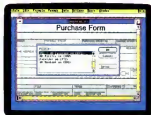
While you probably won't want to move your EMS software to the OS/2 environment, the good news is that you should be able to move these memory boards into the OS/2 operation with, at most, a DIP switch change. In other words, should you decide to make the move to OS/2, you won't have wasted money buying a LIM 4.0 board.

LIM 4.0 boards designed for ATs make the transition easily because they uniform-





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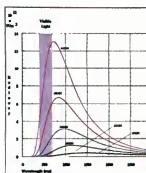
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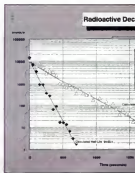
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## ALL IN A DAY'S WORK

*PC Labs LIM 4.0 performance tests are as useful as debuggers as they are instruments of measurement.*

Why would seven memory boards that passed the PC Labs LIM 3.2 benchmark tests—and work just fine with applications that support LIM 4.0—fail our new suite of LIM 4.0 performance tests? That was the unexpected question we had to answer after only Intel's Above Board PS/286 and Above Board 2 turned in satisfactory results on our tests.

The PC Labs LIM 4.0 performance tests don't attempt to simulate the activity of a real-world application. Instead, they start with a set pattern in the physical and logical memory pages, set up each LIM function, call the LIM Expanded Memory Manager device driver, and test the results for validity. Apparently, some applications that support LIM 4.0 do not make use of all of the specification's functions. It was when we tested the boards' ability to address those functions that they failed. The bottom line: testing boards with commercial applications is no substitute for a rigorous test based on the specification itself.

The major failures we found were in function 22 (Alter Page Map and Jump) and function 23 (Alter Page Map and Call). These functions enable program

code to be executed in LIM memory, a technique that is not currently in widespread use. In the future, however, this programming method could be used to place the bulk of a terminate-and-stay-resident (TSR) program in LIM memory, thereby freeing up much-needed DOS memory. The errors we encountered while testing these functions ranged from corrupting the Flags register—a minor offense—to crashing the system.

Upon finding these problems, we contacted each manufacturer's technical support staff. Any doubts we had about the validity of the test results vanished as each manufacturer sent us an updated Expanded Memory Manager that we could retest. These new versions passed all of the tests and are now being shipped with the boards. If you already own one of these boards, simply contact the vendor to obtain a software upgrade.

This type of close cooperation between PC Labs and manufacturers enables us to say that the products we test perform according to spec.

—Stuart R. Greenberg

*Stuart R. Greenberg is a senior programmer at PC Labs.*

ly allow the allocation of their memory between the extended and expanded addressing ranges, and that allocation is hardware mediated. In most cases the only change you'll have to make is resetting switches or running a setup program.

The software that's used to set up some of these AT-style LIM 4.0 boards poses more perplexing problems. In some cases you may not be able to use it at all. For instance, you cannot run AST's extended-memory software emulator because you can't use their expanded-memory driver under OS/2. However, AST also allows the assignment of its memory to the extended area through hardware, too, so the

board itself will work with OS/2.

Products that use DOS software only for setup, such as Newer Technology's Concentration, are merely bothersome under OS/2. Because the Newer Technology setup procedure merely pushes values into memory registers rather than running in the background, it can be run through the compatibility box.

Because the PS/2 and OS/2 were made for each other, you'd think that problems mating the two would be nonexistent and that memory boards designed for PS/2s will work perfectly under OS/2. For up to 2MB, that's true. No PS/2 memory board should have difficulties.

However, beyond 2MB you can encounter problems. Initially, all memory boards stretching beyond that limit would not work with OS/2. The trouble—a PS/2 design faux pas—was located earlier this year, and IBM worked with memory board manufacturers to ensure the compatibility of their products. That's one reason that Orchid's RamQuest Extra has its own on-board BIOS. All of the PS/2 products subject to review here were tested and found to function with both OS/2 and LIM 4.0.

While applications that run in OS/2's extended mode are as scarce as honest politicians, the number of expanded mode programs is impressive and growing, with new versions of *Microsoft Windows* and *Lotus 1-2-3* being of particular interest. The recent revision to the Lotus/Intel/Microsoft expanded memory specification, from version 3.2 to 4.0, promises that more and better tools will soon be in your hands. The memory boards examined here will put LIM 4.0 power into your PC today—and give you the memory you need for OS/2 whenever you decide to make the move.

## PC-and AT-Bus Compatible

AST RESEARCH INC.

### Advantage Premium Rampage 286

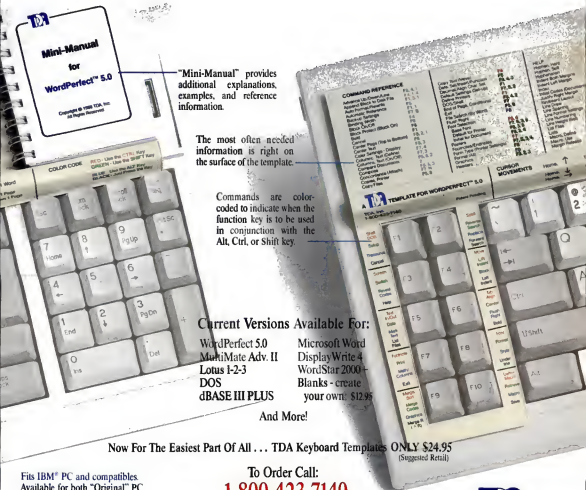
AST Research offers two different LIM 4.0 solutions for PC- and AT-bus computers. The Rampage 286 furnishes 16-bit memory, and the Advantage Premium packs a plethora of ports along with its 16-bit RAM supply. Both are products that have been upgraded from the earlier EEMS specification with new LIM 4.0 software. (If you already have one of these boards and want to upgrade to LIM 4.0, the necessary driver is available for a nominal charge by calling AST's PC Product Support Bulletin Board at (714) 852-1872.)

AST's \$495 (with 0K) Rampage 286 relies on DIP switches to assign its memory to the DOS addressing range, set the expanded memory base I/O address, and control other functions. A second switch

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EDITOR'S  
CHOICE

FACT FILE



AST Research Inc.  
2121 Alton Ave.  
Irvine, CA 92714-4992  
(714) 863-1333

► **Advantage Premium**  
List Price: With 0K, \$445; with 512K, \$545; with 1MB, \$775; game port, \$50; additional daughterboard with 512K, \$450; daughterboard with 1MB, \$650.  
Requires: IBM PC or compatible.  
CIRCLE 612 ON READER SERVICE CARD

► **Rampage 286**  
List Price: With 0K, \$495; with 512K, \$695; with 2MB, \$1,195.  
Requires: IBM PC AT or compatible.  
In Short: The Advantage Premium is a 16-bit memory board with two serial, one parallel, and one game port that's set up through DIP switches to add 1MB to ATs or 2MB with optional daughterboard. Can be combined with several Rampage 286 boards for up to 8MB per system. The Rampage 286 is a 16-bit LIM 4.0-compatible memory board that adds up to 2MB. It is set up using DIP switches. Up to four boards can be added to a system for 8MB expansion.  
CIRCLE 703 ON READER SERVICE CARD

bank allows setting total memory size so that you can cram up to four Rampage 286 boards in a single system (giving you a maximum endowment of 8MB). You can also defeat parity checking by setting another switch.

The Rampage 286 includes setup software to allocate memory in the expanded range and add entries to your system's CONFIG.SYS file for utility programs. (It will also set up emulated extended memory for use by the AST utilities that may require it.)

The full-length, XT-height Rampage 286 board holds 72 sockets physically arranged in eight banks, logically in four. The board is compatible only with 256-kilobit memory chips rated at 120 nanoseconds or better; this allows it to be used in

computers with bus speeds of 8 MHz or less, including ATs and the XT Model 286. Because memory must be added 18 chips at a time, possible board capacities include 512K, 1MB, 1.5MB, and 2MB.

The Advantage Premium (\$445 with 0K) adds up to two serial, one parallel, and one game port to the capabilities of the Rampage 286. However, its fundamental design is quite different. The board itself holds only 1MB divided among 36 sockets for 256-kilobit DRAM chips. A second megabyte, comprising 36 256-kilobit chips soldered to a daughterboard, extends single-slot capacity to 2MB. (A 512K daughterboard is also available.)

The extra ports of the Advantage Premium consume additional glass-epoxy real estate, so much that the full-length board fits only in AT-height computers. Although you'll want to put only a single Advantage Premium in your computer (other-

wise you'd waste ports), you can combine one with up to three Rampage 286 boards.

Besides the memory configuration switches like those used on the Rampage 286, the three DIP-switch banks of the Advantage Premium allow you to selectively enable its ports. A bevy of on-board jumpers allows you to select which serial lines you want active. Software setup for the LIM 4.0 driver and AST's utility software is included.

The connectors used by the Advantage's ports follow the AT standard: serial ports use male 9-pin D-shell connectors; parallel ports use 25-pin female connectors. The optional (\$50) game port and (\$50) second serial port come with cables and connectors that attach to on-board headers. Both serial ports use a 16450 UART (Universal Asynchronous Receiver/Transmitter) chip, same as the AT.

All three boards share the same Super-

## FEATURES SPELL PERFORMANCE

*You can get by with a board that doesn't provide all the features of the LIM 4.0 spec, but would you want to?*

**L**IM 4.0 can be both versatile and adaptable, which is both a strength and a weakness. As a standard, it assures you that any LIM 4.0 software product will work with any LIM 4.0 hardware product. But its very flexibility means that not all applications will run optimally on all memory boards.

The LIM 4.0 standard allows the expanded memory driver to match the facilities that its associated memory board provides to the requirements of the software you want to run. The driver makes allowances so that a memory board does not have to provide all the features that LIM 4.0 allows in order for a given application to work.

For instance, a LIM 4.0 memory board need not be able to page through all 1MB of the real-mode addressing range of Intel microprocessors. It could be restricted to the four-page limit of EMS 3.2. LIM 4.0 software will still work on

the board because its LIM 4.0 driver accommodates the limitations of the hardware, helping the software do what it can under those constraints.

The bottom line is that the LIM 4.0 board that lacks some of the features of the specification will work, but it won't deliver full performance. It may have to do a lot of fancy footwork and juggle dozens of pages into the four available slots, stealing your software's speed.

Such differences between LIM 4.0 boards will not show up when you run programs that take advantage of the EMS 3.2 specification. That software will have everything it wants waiting for it even in a minimal LIM 4.0 implementation. Performance degradation is likely to show up when you try to run newer software that has been written to the LIM 4.0 standard, particularly operating environments and programs that provide multitasking. —Winn L. Rosch

## ■ LIM 4.0 BOARDS

Pak of utilities (disk emulator, print spooler, and others), design quality, workmanship, and LIM 4.0 driver. All but the last are up to (or even set) today's industry standards. In the PC Labs 128-Kbyte and 64-byte Move Tests, the boards turned in very respectable results. Choose these boards for their full LIM 4.0 support, good performance, and quality—not for price.

### BOCA RESEARCH INC.

#### Bocaram/AT

Designed to fit the 16-bit AT bus, the full-length \$225 (with 0K) Bocaram/AT is compatible not only with ATs and their compatibles but also, because of its low height, with the XT Model 286. Fully stuffed, the Bocaram/AT can bless your system with up to 2MB of extended memory; up to 2MB of that can be assigned as expanded memory under the LIM 4.0 specification.

This memory is arranged in eight banks of nine parity-checked DRAM chips. Because of its 16-bit nature, banks must be filled in pairs. All banks except for the first two use 256-kilobit chips rated at 150 nanoseconds or faster (the review unit was equipped with 100-ns. chips).

The first pair of banks is optionally able

to handle 64-kilobit chips, which are put to use when backfilling ATs with 512K of RAM on the system board. While 256-kilobit chips can be used in these sockets, the Bocaram/AT cannot divvy up the capacity of these chips between conventional and extended memory. Consequently 384K is lost in the backfill operation.

Minimum board capacity is either 128K or 512K, depending on the chips in the first two banks; maximum capacity is 2MB. Additional extended or expanded memory can be added in 1/2-MB increments, up to their respective limits.

A \$125 (with 0K) daughterboard, also with a 2MB capacity, can be grafted onto the Bocaram/AT to increase the capacity of one slot to 4MB (of which only 2MB can be LIM 4.0, according to the company). The daughterboard mates with two headers on the Bocaram/AT, component side to component side, and receives no other physical support—a somewhat flimsy arrangement.

You use two banks of DIP switches and two jumpers to set up the Bocaram/AT. The switches and one jumper configure the base address of the board and the division of its memory between extended, expanded, and conventional memory. Other switches determine EMS base and frame addresses. The other jumper adjusts the Bocaram/AT to the speed of the host system by adding wait states.

The board will operate with no wait states at up to 12 MHz, and at up to 20 MHz with wait states—but presumably not with the 150-ns. chips the factory recommends. In testing, the Bocaram/AT, like the Intel Above Board PS/286, yielded some of the slowest results in both the 128K-byte and 64-byte Move Tests.

Boca Research packages the Bocaram/AT with software that will automatically install the LIM 4.0 driver. Other supplied software includes a RAMdisk and setup program, a printer spooler, drivers for older expanded-memory versions, and two test programs. The version of the software we tested—version 1.4—failed to correctly perform four LIM 4.0 functions. After we notified the company of these problems, Boca Research made the requisite corrections to its software. A new release, Version 1.5, is available free to all registered users.

The vendor also offers a similar board, the Bocaram/30, which is designed to add up to 2MB of EMS memory to the PS/2 Models 25 and 30. It's equipped with an 8-bit data bus and rated at 12 MHz maximum speed.

The engineering, design, and manufacturing quality of the Boca boards rate as top-notch. Documentation deserves a big OK—hardly exemplary, but enough to muddle through with. For its price, the Bocaram/AT rates as a bargain.

### INTEL CORP.

#### Above Board PS/286

If there were an award for the most misleading product name, Intel's Above Board PS/286 would be a prime contender. The \$695 (in minimal 512K configuration) board is not meant for the IBM PS/2 series of computers, nor is it restricted for use with machines based on the 80286 microprocessor.

The former part of the moniker can be explained—the "PS" stands for "Parallel and Serial" ports, with which the board comes equipped. (An optional second serial port costs \$100.) A similar product with-

**EDITOR'S CHOICE**

**PC MAGAZINE FACT FILE**



**Above Board PS/286**  
Intel Corp.  
PCEO (Personal Computer Enhancement Operation)  
5200 NE Elam Young Pkwy.  
Hillsboro, OR 97124-6497  
(800) 538-3373  
List Price: With 512K, \$695; with 2MB, \$1,595; daughterboard with 512K, \$545; second serial port, \$100  
Requires: IBM PC, PC-XT, PC AT or compatible, or IBM PS/2 Model 30.  
In Short: The Above Board PS/286 features LIM 4.0 support and works in both 8- and 16-bit computers. Parallel and serial ports are standard.

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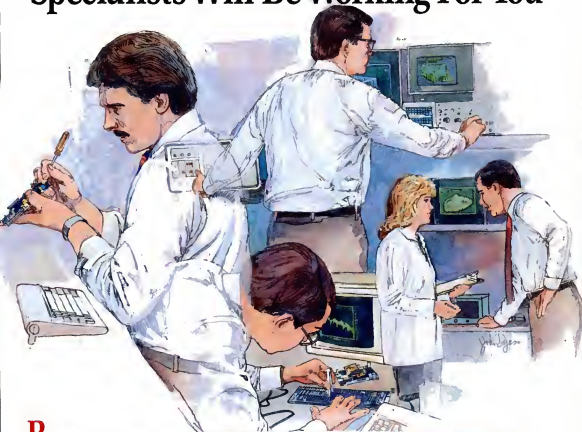


**Bocaram/AT**  
Boca Research Inc.  
6401 Congress Ave.  
Boca Raton, FL 33487  
(407) 997-6227  
List Price: With 0K, \$225; with 128K, \$275; with 512K, \$445; with 1MB, \$695; with 2MB, \$1,195; with 4MB, \$2,295.  
Requires: IBM PC AT, PC-XT Model 286, or compatible.  
In Short: A full-length, XT-height memory-only board for the 16-bit AT bus that adds up to 2MB of LIM 4.0 memory or 4MB (using a daughterboard), in a single slot.

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## LIM 4.0 BOARDS

out ports is dubbed merely the Above Board 286. While, in truth, either will work with 80286 computers, these memory/multifunction boards can also endow the PC and its 8088- or 8086-based kin with expanded memory.

The basic board runs the full length of any XT-height expansion slot. Although it is equipped with an AT-style 16-bit edge-connector, Intel provides a simple jumper that converts the board to 8-bit operation, the extra connections dangling outside the host machine's bus connector.

The RAM on the Above Board—eight socketed nine-chip banks stuffed cheek-to-jowl with virtually no space in between—can be assigned to any standard memory class: conventional, expanded, or extended. Of course, extended operation is not possible in 8088 machines, which cannot address RAM above 1MB.

The Above Board itself holds 2MB of 256-kilobit DRAM chips. A piggyback memory daughterboard pushes the possibilities to 4MB. At minimum, two nine-chip banks—512K RAM—must be installed. Adding more chips permits any 512K increment between that minimum and the board's 2MB maximum.

Intel rates the Above Board for use in 80286-based computers operating as fast as 12.5 MHz. In 8088-based computers, the speed limit is 8 MHz. For operation at speeds above 10 MHz, Intel recommends using chips rated at 120 ns, or faster. The review sample arrived equipped with 70 chips rated at 120 ns, and two at 150 ns. Evidently, you can mix chip types as you please—at least Intel does.

The Intel Above Board PS/286 tied with the Bocaram/AT in turning in the slowest results on both of the Move Tests. Similarly, the Above Board 2, which is designed for the PS/2 line, was considerably slower than its competition in that product category.

As with most of today's state-of-the-art enhancement products, the Above Board has no switches or jumpers for setup. Instead, you run a menu-driven installation program called SETBOARD, which assigns memory types, sets base and I/O addresses for expanded memory, and sets up the serial and parallel ports. A second program, INSTALL, handles the software part of installation, adding entries to your

AUTOEXEC.BAT and CONFIG.SYS files to set up the print buffer, RAMdisk, and expanded memory. It even copies the Intel software to your hard disk.

The serial and parallel ports follow AT practice. The serial port is equipped with a male 9-pin D-shell connector on the card-retaining bracket. The 25-pin female D-shell connector of the parallel port is just below. The second serial port is available

## ■ The design and manufacturing quality of the Above Board PS/286 are beyond reproach.

only as a header on the card itself and requires an adapter and connector. Adding the second port also requires a second UART (Universal Asynchronous Receiver/Transmitter) chip.

The design and manufacturing quality of the Singapore-made board are beyond reproach. The documentation is also very good, divided into sections for beginner and expert levels.

Although the Above Board PS/286 is a software upgrade of Intel's EMS 3.2 product, it is fully compatible with the LIM 4.0 specification. In fact, both the Above Board PS/286 and Above Board 2 were the only products of this group that, on the first try, did not fail to perform any of the functions we tested. If you can live with the board's slow performance, you can count on its conforming to the LIM 4.0 spec.

## MICRON TECHNOLOGY INC.

### Micron Memory Board

Micron Technology is America's premier memory maker, the only U.S. company that still makes virtually nothing but DRAM. The memory-only Micron Memory Board is exactly the kind of product you'd expect from Micron's systems division: simply a vehicle for putting its chips to work in an AT expansion slot.

Micron is so intent on selling you its chips that you can't buy the board by itself.

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## ■ LIM 4.0 BOARDS

It's only available equipped with factory-supplied chips—\$700 with 1MB, \$975 with 2MB. You can add a daughterboard and stretch the price and capacity to \$1,799 for 4MB.

In any of its incarnations, the Memory Board will support the LIM 4.0 spec as well as its included EMS 3.2 and EEMS standards. The board can also backfill conventional memory from 256K or 512K, up to 640K, and divide its remaining capacity between extended and expanded memory in any way you want.

The Memory Board is a full-length, XT-height card made to fit low-rise machines like the XT Model 286. It's made to use only 256-kilobit chips, and in 2MB dress (as the review unit was received) all memory chips are soldered. The 1MB version has four nine-chip banks soldered to the board and provides an equal number of sockets for expansion. Micron supports the installation solely of its own 256K

DRAM products in these sockets (although other makers' chips will work). A piggyback board can add 2 more MB of extended memory to the EMS board. All memory is parity-checked.

Micron rates its EMS board's speed at 8

MHz with zero wait states or 12 MHz with one. Zero-wait-state operation can be defeated by software command during setup. On the 128-Kbyte Move Test, the Memory Board was one of the fastest performers. However, on the 64-byte test the board



### FACT FILE



**Micron Memory Board**  
Micron Technology Inc.  
Systems Group  
2805 E. Columbia Rd.

Boise, ID 83706  
(800) MICRON-1  
(208) 386-3800

**List Price:** With 1MB, \$700; with 2MB, \$975; with 4MB, \$1,799.

**Requires:** IBM PC AT, PC-XT Model 286, or 16-bit compatible.

**In Short:** A memory-only board that packs up to 2MB (4 with optional daughterboard) of 16-bit memory into a full-length, XT-size slot.

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dropped back to the mid-range.

As with PS/2s, all operating parameters of the Memory Board are set through software, in this case using Micron's own program. Menu-driven, it allows fast and convenient selection of the frame and I/O addresses used by the board, oversees the functional division of its capacity, and handles testing. As with PS/2s, bad memory areas on the Memory Board can be mapped out of use, and parity checking can be disabled. Micron also includes three EMS drivers (one each for the major specs—EMS 3.2, LIM 4.0, and EEMS), a RAMdisk, and a printer spooler.

The software we tested, Version B4.1, failed to perform two LIM 4.0 functions and caused the system to crash when it tried to accomplish 128-Kbyte moves. After we called Micron, the vendor sent new, improved software, Version B4.2. The new version should be available by the time this article hits the newsstands.

The documentation offers an unusually good explanation of the various types of memory used in IBM computer systems. Other than its resemblance to the printshop work of a high school vocational-education class, the manual rates as quite good overall. Workmanship on the board itself is as good as any, and better than most.

The strong point of the Micron Memory Board is its configuration flexibility; its weak point, the limited chip and capacity choices. If you don't mind dealing in megabyte (today, that's about \$500) increments, you'll find the Micron Memory Board a useful choice.

### NEWER TECHNOLOGY Concentration

Once you appreciate the amount of memory Newer Technology's Concentration board shoehorns into a single AT expansion slot, its name doesn't sound a bit un-

usual. One Concentration can pack up to 32MB—twice as much as the 80286 microprocessor in such computers can directly address. Software from Newer Technology and the LIM 4.0 standard can put every byte of that horde to work.

Basically a memory vehicle, the Concentration can be outfitted in one of two ways. For those who favor injecting their own RAM, the board is available decorated with 16 SIMM sockets, allowing you to plug in up to 16 1MB modules. If you prefer sheer quantity to flexibility, the factory will solder down a full 32 1MB SIMMs for the maximum board memory. The reason for this twofold strategy is simply that sockets require more room than SIMMs alone.

The board itself supplies nothing but interface circuitry and memory. Even the LIM 4.0 controller is an optional daughter-board called a Memory Mapper.

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## ■ LIM 4.0 BOARDS

centration of 32MB, the daughterboard is a worthy addition. It's designed to squeeze the most that the specification allows, using multiple hardware registers for greater performance.

Newer Technology also supplies its own RAMdisk program, which it claims is substantially faster than the VDISK program included with PC-DOS. In addition, the Newer Technology RAMdisk can take

advantage not just of the full memory of one Concentration, but also it can logically link four Concentrations together to produce a massive 128MB virtual drive.

The memory of the Concentration can be split between conventional, expanded, and extended during its setup procedure. Memory can also be used to backfill system boards starting at any 128K boundary. Backfilling from the 256K boundary of the host system (and the removal of the host memory chips from the address range above this boundary) is recommended for best possible LIM 4.0 operation.

For all of the technical finesse of the Concentration, its performance on the 64-byte Move Test proved lackluster. The board fared better on the 128K-byte move test, ranking with the fastest of its competitors.

Originally, we found that the board's software—Version 1.04—failed to perform nine LIM 4.0 functions. Newer Technology sent us new software that corrected these problems. A new release, Version 1.05, is being automatically sent to registered users.

The Concentration itself is a single full-length, XT-height expansion board that uses the AT-style 16-bit data bus. Except for memory, its active components use surface-mount packaging. Its layout is marred by a number of wire jumper circuit "fixes," an add-on capacitor, and small wire loops substituting for an unneeded resistor network.

You set up the Concentration through software, except for setting a single jumper that determines whether 256K or 1MB SIMMs are used on the board. All SIMMs on the board must be of the same capacity.

You must set another jumper only if something goes awry with the board's electronic memory that interferes with the operation of the host system. Shorting these jumper pins resets the Concentration's EEPROM memory to the factory defaults.

The setup software allows you to select operating parameters, including the number of wait states it injects into each microprocessor cycle. Newer Technology does not recommend any speed limit or wait-state setting. Instead, its documentation recommends a trial-and-error ap-

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CIRCLE 212 ON READER SERVICE CARD

PC  
FACT FILE

FACT FILE



#### Concentration

Newer Technology  
1117 S. Rock Rd., #4  
Wichita, KS 67207  
(316) 685-4904

**List Price:** With 0K, \$525; Memory Mapper Board (LIM 4.0 support), \$150; 256K SIMM memory module, \$135; 1MB SIMM memory module, \$575

**Requires:** IBM PC AT or compatible.

**In Short:** This memory-only board allows for complete software setup of all parameters and provides LIM 4.0 compatibility with its optional Memory Mapper Board.

CIRCLE 706 ON READER SERVICE CARD

proach—step down from the fastest speed until you find one at which the board operates reliably.

Overall, the documentation is terse but adequate and has a professional look—an other triumph of desktop publishing.

The Concentration earns high marks for its capacity, performance, and full implementation of the LIM 4.0 specification. It needs only about one more iteration of circuit-board design refinement and, perhaps, quicker LIM 4.0 driver software.

## Micro Channel PS/2 Compatible

INTEL CORP.

### Above Board 2

From the company that was one of the inventors of the EMS standard, you should expect an inventive product. Instead, the Intel Above Board 2 is slightly quirky and a bit of a throwback, although it's entirely workable as a memory enhancement for your PS/2 Model 50 or 60.

The \$445 (with 0K) Above Board 2 is fundamentally a platform for 2MB of memory. It contains eight sockets for

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## ■ LIM 4.0 BOARDS

256K SIMMs. Because of the 16-bit nature of the Models 50 and 60, SIMMs must be added in pairs. This arrangement allows Above Board capacities from 512K to 2MB in 512K increments. The board cannot use 1MB SIMMs.

Unlike more-conventional products and somewhat at odds with the PS/2 philosophy, the Above Board 2 requires you to set on-board DIP switches to reflect the number of SIMMs installed. After you do that, hardware installation is much like that of any other PS/2 add-in. Just run the setup procedure on your system Reference Disk.

Once the hardware is installed, you can bring the EMS memory to life by running Intel's setup program, SoftSet. The menu-driven software automatically copies the Intel support programs to your hard disk and gives you menu-driven control over setting up EMS, a printer spooler, and one or two RAMdisks.

Intel allows one other option. You can substitute 1MB of the RAM on the Above Board 2 for the planar board memory in your PS/2. Ordinarily that would not confer a big benefit. However, when the Above Board 2 is loaded with 100-nanosecond SIMMs, it can run without wait states, accelerating your PS/2 by 20 percent or more. Intel also includes another DIP switch for no-wait-state operation.

### PC FACT FILE



#### Above Board 2

Intel Corp.  
PCE0 (Personal Computer Enhancement  
Operation)  
5200 NE Elam Young Pkwy.  
Hillsboro, OR 97124-6497  
(800) 538-3373  
List Price: with OK, \$445; with 2MB,  
\$1,995.

Requires: IBM PS/2 Model 50 or 60.

In Short: A Micro Channel memory expansion board that adds up to 2MB of 16-bit DRAM and includes full LIM 4.0 support.

CIRCLE 708 ON READER SERVICE CARD

The Above Board 2 is well made, although it uses conventional pin-in-hole rather than surface-mount technology. The board is dominated by two Intel custom VLSI chips.

Documentation is clearly written and cleverly subdivided into sections for inexperienced and expert users, expert apparently meaning that you've peeked inside your computer before. Lacking are explanations of the options with which the SoftSet program automatically fills your AUTOEXEC.BAT and CONFIG.SYS files.

The Above Board 2 will undoubtedly work well in your PS/2. Like the Intel Above Board PS/286, it was the only board that correctly performed all the functions we tested for, right out of the box. Its only shortcomings are philosophical misunderstandings (or underappreciations) and its slow performance—it was the slowest of the three PS/2-compatible boards we tested. If you can live with those, you can make good use of the Above Board 2.

## ORCHID TECHNOLOGY RamQuest II RamQuest Extra

The first to introduce an aftermarket memory expansion board for the Micro Channel, Orchid Technology has been steadily improving and upgrading its product line for PS/2s. The RamQuest II and RamQuest Extra represent the most recent incarnations of those development efforts.

Although both are memory boards for the Micro Channel, the two products use different approaches and technologies to achieve their goals.

The chief functional distinction between the twin is that the RamQuest Extra has greater capacity and offers a pair of serial ports as a bonus. The RamQuest II is more a meat-and-potatoes product, a straight memory add-in with a capacity limit of 2MB. Both products can be used in any Micro Channel PS/2, from the Model 50 through the Model 80, although their 16-bit interfaces may hold back system performance in the 32-bit Models 70 and 80. Technically, however, they are as different as night and day.

The RamQuest II starts with a base of

1MB of soldered memory in one big, 36-chip bank of 256-kilobit zigzag in-line integrated circuits. Two 18-chip banks of sockets are also available for holding more conventional dual in-line packages 1- by 256-kilobit memory chips. If you want to add your own chips to the board, Orchid suggests that they be 120-ns. or better.

Notwithstanding the switchless philosophy of the Micro Channel, the RamQuest II includes three jumpers that you must set to reflect the number of banks of memory to be used on the board. Otherwise, installation is simply a matter of plugging in the board and running normal IBM setup procedures using your Reference Diskette.

The Micro Channel interface is handled by a single VLSI chip and an Orchid proprietary PAL. Otherwise, the board is completely constructed from soldered lead-in-hole logic chips. Manufacturing quality rates with the best, and the boards are sure to stand out in your PS/2 with their oddly colored plastic guides—orchid, rather than blue.

The \$599 (with 0K) RamQuest Extra fits more with the feel of the Micro Channel. It mixes both lead-in-hole and surface-mount technologies and requires no physical setup of the hardware; its one jumper is for factory testing. It incorporates its own on-board BIOS to ensure full operating system compatibility (including OS/2 support).

The board contains eight sockets for SIMMs, logically grouped in pairs. As long as a pair of sockets is filled with the same size SIMMs, you can mix either 256K or 1MB modules on the board. The RamQuest Extra is smart enough to sort out whatever you do: it will even fill non-adjacent banks.

The minimum factory configuration is zero memory. According to the documentation, the only other factory option is 512K. Orchid includes clear instructions for adding more SIMMs, but the only guidance it offers for selecting the proper modules is a required speed rating of 120 ns. Orchid does not supply a list of compatible parts.

The two serial ports are based on the same 16550 UART chips as are IBM's PS/2 serial ports. For space reasons, however, the port connectors follow the 9-pin male D-shell connector standard used by



## FACT FILE



Orchid Technology  
45365 Northport Loop West  
Fremont, CA 94538  
(415) 490-8386

### RamQuest II

List Price: With 1MB, \$849

Requires: IBM PS/2 Model 50 or 60.

CIRCLE #11 ON READER SERVICE CARD

### RamQuest Extra

List Price: With 0K, \$599; with 512K,

\$899; with 1MB, \$1,199.

Requires: IBM PS/2 Model 50, 60, or 80.

In Short: The RamQuest II is a LIM

4.0-compatible memory expansion board for

PS/2s that puts up to 2MB in a single slot.

The RamQuest Extra is a LIM 4.0-compatible

memory expansion board for Micro

Channel PS/2s that adds up to 8MB along

with two serial ports. Built-in BIOS assures

OS/2 compatibility, but the board's installation

procedure is a bit finicky.

CIRCLE #17 ON READER SERVICE CARD

the AT, instead of that of PS/2s.

The RamQuest Extra is as colorful as the RamQuest II, but it's not quite as well made. Several jumper wires that adorned the rear of the board we evaluated looked as if they were grafted into place by a 5-year-old with a woodburning set. In addition, the multitude of ICs on the board also included one 8-pin mystery chip, its identification sanded off apparently for some security reason.

Both Orchid products were accompanied by the same complement of software: a RAMdisk program, a printer utility program that included spooling, and installation programs for this software. They turned in almost identical performance on both Move Tests, and overall yielded the fastest results.

The installation procedure for both boards was nicely integrated into the PS/2 setup. The RamQuest Extra proved troublesome in installation, however. Unless you follow the instructions to the letter—including copying the necessary

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CIRCLE 173 ON READER SERVICE CARD

## ■ LIM 4.0 BOARDS

ADF file to your Reference Disk before physically installing the board—you will be doomed to failure. Other PS/2 products are not so persnickety. According to Orchid, the strict installation order is necessitated by the on-board BIOS.

Documentation is exemplary, lacking only a list of compatible memory chips. The automatic installation procedures are complemented by a listing of options that

let you make adjustments by using a text editor rather than the installation program.

While the RamQuest II earns a hearty recommendation as it stands, the RamQuest Extra could use a more forgiving in-

stallation procedure and some refinement in its construction.

Winn L. Rosch is a contributing editor of PC Magazine.

## PC EDITOR'S CHOICE

- Above Board PS/286
- Above Board 2
- Advantage Premium
- Rampage 286

Choosing a LIM 4.0 board depends a lot on what you have and what you want. The computer you want to enhance determines whether you want a PC-bus or Micro Channel board; your budget and impatience determine how much you want to spend to get the highest level of performance.

Of the boards designed for the PC bus, AST's Advantage Premium and Rampage 286 stand out for both performance and compatibility. With list prices of \$445 and \$495 (with OK) respectively, they can't beat the \$225 Bocaram/AT on price. But if you're looking for speed, count on the extra hardware registers on these two boards to do the job.

Although Intel's Above Board PS/286 (\$695 with 512K) and Above Board 2 (\$445 with OK) were among the slowest performers in their respective product categories, we liked them because they were the only boards that didn't require any changes to their Expanded Memory Managers. Both boards passed our LIM 4.0 compatibility tests on the first try, which suggests there's some wisdom in buying a board made by the manufacturer that wrote the spec.

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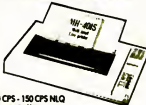
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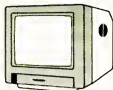
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## I/O (Input/Output) Statements

**CLOSE** — Closes a device or file

**SYNTAX:** CLOSE [(#)filename[(, #)filename]...]

**NOTE:** CLOSE with no parameters will close all open devices and files.

**FIELD** — Allocates space for variables in random file buffer

**SYNTAX:** FIELD (#)filename, length AS stringvar [,length AS stringvar]...  
length — number of character positions for stringvar

**GET** — Read a record from a random file

**SYNTAX:** GET [(#)filename [,n]]

n — record number (1 to 16 million). Default record after last read. If used on a COM device, number of bytes to read from communications buffer.

**INPUT** — Get keyboard input

**SYNTAX:** INPUT [(, "prompt;") variable [, variable]...]

prompt — a string constant that prompts for input  
**NOTE:** Use a comma instead of a semicolon after the prompt string to suppress the question mark.

**INPUT #** — Read from sequential device or file into variables

**SYNTAX:** INPUT #filename, variable [, variable]...

**LINE INPUT** — Read entire line (up to 255 chars) from keyboard

**SYNTAX:** LINE INPUT [(, "prompt;") stringvar]

prompt — string constant that prompts for input  
**NOTE:** Optional semicolon after LINE INPUT suppresses carriage return/line feed after input.

**LINE INPUT #** — Read an entire line from a sequential file

**SYNTAX:** LINE INPUT #filename, stringvar

**LPRINT** — Output data to printer

**SYNTAX:** LPRINT [(list)] [(,)]

**NOTE:** list is any combination of variables or numeric or string constants. A trailing semicolon suppresses the carriage return/line feed.

**LPRINT USING** — Output formatted data to the printer

**SYNTAX:** LPRINT USING formatstring, list [(,)]

formatstring — a string that controls how the output will be formatted. Valid chars for formatstring are

! — print only first char of string  
n spaces — print 2+n chars from the string  
& — output string exactly as input  
\_ — pass next char literally

numeric fields:

# — a digit position  
+ — print sign  
- — print negative numbers with trailing minus  
\*\* — fill leading spaces with asterisks  
\$\$ — print with leading dollar sign  
\*\*\$ — combines \*\* and \$  
., — print comma every three digits  
#### — use scientific notation

**LSET** — Move data into file buffer (left justified)

**SYNTAX:** LSET stringvar = string

stringvar — usually a variable defined in a FIELD statement

**OPEN** — Open file or device for input or output

**SYNTAX:** OPEN filename [(FOR mode) AS (#)filename [(LEN=n)]]

—or— OPEN mode2[(#)filename, filespec, [,n]]

mode —

OUTPUT	sequential output
INPUT	sequential input
APPEND	output appended to end of file
(omitted)	random access

mode2 —

"O"	sequential output
"I"	sequential input
"R"	random access

filename — an integer from 1 to the maximum number of files allowed. Default maximum is 3 — change with /F switch on BASIC command line.

n — record length 1..32767. Default 128.

**OPEN COM** — Open communications

**SYNTAX:** OPEN "COM:n: [speed] [(, parity) [, data] [, stop] [(, RS) [(, CS[ms]) [(, DS[ms]) [(, CD[ms]) [(, LF) [(, PE) AS (#)filename [(LEN=number)]]

n — com port (1 or 2)

speed — bits per second. Valid rates are 75, 110, 150, 300, 600, 1,200, 1,800, 2,400, 4,800, 9,600. Default 300.

parity — one character from the following:

S	Space
O	Odd
M	Mark
E	Even
N	None

data — number of data bits, 5, 8. Default 7.

stop — number of stop bits, 1 or 2. Default 2 for 75 and 110 bps, 1 for all others.

number — length of communications buffer. Default 128 bytes.

ms — milliseconds to wait before timing out on line signal options (0..85535). If 0 or omitted, line signal option not checked.

Line signal options:

RS	suppresses Request To Send
CS[ms]	controls Clear To Send
DS[ms]	controls Data Set Ready
CD[ms]	controls Carrier Detect
LF	adds line feed after carriage return
PE	enables parity checking

**NOTE:** Any error in the parameters string between the quote marks will result in a "Bad file name" error.

**PRINT** — Display data on screen

**SYNTAX:** PRINT [(list)] —or— ? [(list)] [(,)]

(See NOTE re LPRINT)

**PRINT USING** — Output formatted data to the screen

**SYNTAX:** PRINT USING formatstring, list [(,)]

formatstring — (see LPRINT USING)

—Nell J. Rubenking



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■ UTILITIES ■ DOUGLAS BOLING

# SPEED UP HARD DISKS WITH DCACHE

*While IBM has a disk-caching program for PS/2 models, it doesn't have one for PCs. Here's a utility PC owners can use to make hard disks seem to run up to 50 percent faster.*

The unending quest for greater computer speed began when the first man greased the rails of an abacus. Whether in listing a directory, loading a program, or recalculating a spreadsheet, perceived speed is perceived power. The best way to increase your computer's speed, however, is not necessarily to rush out and buy the latest accelerator board or a faster crystal. Like most PC operations, the first two of the three examples above involve the disk drive. Disk operations, not a difference in microprocessor or clock rate, are what made the IBM PC-XT so much faster than the PC.

The speed difference between the PS/2 Models 50 and 60 provides a more recent and instructive example. Both run at the same 10-MHz, one-wait-state speed, but users initially criticized the slowness of the Model 50. IBM provided a solution in the form of a program called IBMDCACHE.COM, which comes with the reference diskette for the Model 50/60. This excellent program speeds up the Model 50 to the point where it nearly matches the Model 60. (If you use a Model 50, 60, or 80 and you haven't discovered IBMDCACHE.COM, be sure to read the sidebar "Hidden Gold in the PS/2.")

If you haven't purchased a PS/2, however, the DCACHE.COM utility presented here is the way to go. A terminate-and-stay-resident program, DCACHE is a hard disk cache that speeds up your computer by cutting the disk access time by as much as 50 percent. It reduces response time by keeping the most recently used data from the disk in its own reserved section of

RAM. Then, when the hard disk is asked for data, DCACHE looks to see if the requested data is already being held in RAM. If so, DCACHE returns the data to DOS without having to waste time accessing the disk.

The quickest way to get your own copy of DCACHE.COM is to download it from

PC MagNet, as explained in the sidebar "DCACHE by Modem." If you don't have a modem, both the assembly language listing (DCACHE.ASM) and an alternative BASIC program (DCACHE.BAS), which will automatically create DCACHE.COM when run once, are presented here.

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DCACHE speeds up your computer by cutting disk access time in half.

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Ray Duncan deals with reader feedback on his recent columns.

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### PC TUTOR

Examining COMMAND.COM reveals how DOS clears the screen.

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Discovering the spark gap on 3Com cards; networking a small office.

**USING DCACHE** You can install and activate the DCACHE program simply by entering the command below either at the DOS prompt or as a line in your AUTOEXEC.BAT file. Its full syntax, including optional parameters, is

```
DCACHE [/OFF] [/ON] [/U] [/MX] [/Z] [/HMX]
```

The DCACHE default parameters upon loading activate a cache of 64K in size, located in low memory, and cache the primary hard disk. DCACHE can be customized for any machine by using command-line parameters. The size of the area of RAM reserved by DCACHE can be adjusted from 16K to 8MB by including the /MX parameter, where x is the size (in kilobytes) desired. Allowable values for x are 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, and 8192. To specify a 256K cache the command would be DCACHE /M256. DCACHE uses about 1,200 bytes in addition to the amount of memory specified for the cache.

DCACHE provides the option of using memory that conforms to the Lotus/Intel/Microsoft expanded memory specification. In fact, to use caches larger than 256K, the use of expanded memory is required. To specify expanded rather than

## ■ UTILITIES

conventional memory, simply include the /E parameter when you execute DCACHE.

AT-compatible computers usually allow two hard disks to be attached to the disk controller. DCACHE allows you to specify the disk you wish to cache. If you wish DCACHE to cache the secondary disk, put the /H1 parameter on the command line. (The default, the primary disk, is /H0.) It is important to note that DCACHE caches the physical disk, not the logical DOS partition of a disk. DCACHE treats a partitioned disk as one disk.

DCACHE allows itself to be removed from memory. If you are using DCACHE in conventional memory and you see that dreaded message "Program too large for memory," you can simply enter the command DCACHE /U to uninstall DCACHE and free the memory it was using. The limitation here is that for /U to work DCACHE must be the last TSR program installed. Additionally, the BIOS disk interrupt (13h) must not have been altered since DCACHE was installed. If the interrupt has been changed, DCACHE prints an error message indicating that the cache cannot be removed.

Without uninstalling it, DCACHE can be disabled and enabled on command. To

disable DCACHE, you simply enter DCACHE /OFF. Once the cache is disabled, all disk accesses will be passed directly to BIOS, without caching. To enable the cache again, enter DCACHE /ON. When DCACHE is installed, the cache is automatically enabled. To install the cache and immediately disable it, include /OFF with the other installation commands. ON, OFF, and Uninstall are the only DCACHE commands allowed after the cache has been installed.

If you forget the command-line switches and don't have this article around, typing DCACHE ? will present a short list of the allowable commands without installing the cache. If DCACHE has already been installed, only the /ON, /OFF, and /U commands will be listed. If you try to install DCACHE a second time, an error message will be printed along with the allowable commands.

**CACHING METHODS** Before describing the inner workings of DCACHE, I will discuss how caches work in general. Although I'll focus on disk caches, the concepts can be applied to other types of caches as well. One point to be clear about at the outset is that DCACHE does not know or care what data it is caching. (This is typical of most types of caches.) DOS's

organization of a disk using file allocation tables, clusters, and partitions is completely independent of DCACHE. This is the reason DCACHE treats a physical disk that contains several "logical" (partitioned) drives as a single disk. DCACHE simply caches data depending on what sectors are read and written.

There are two data areas in a cache, one large and one quite small. The larger of the two areas holds the actual disk data. The data area is subdivided into units called pages, which are the smallest blocks of data the cache will read from the disk. The second, smaller area is called the cache directory. The cache directory holds labels, called tags, which describe where the data in each page came from. For each page in the cache there is a corresponding tag in the cache directory.

The data on a disk drive is organized in pages that are the same size as the pages in the cache. A page on the disk is addressed by the logical sector number of the first sector in the page. The logical sector number is computed in the same way that DOS does it: by numbering each sector sequentially, starting with the first sector of the first head on the first cylinder of the disk. This numbering is continued up to the last sector of the last head on the last cylinder of the disk.

A page may be composed of one or more sectors. The cache reads data from the disk in multiples of pages. If DOS requests only part of a page, the cache still reads an entire page but passes only the requested sectors of the page to DOS. The cache saves the entire page in case DOS requests other sectors from the page in the future. These pages are designed to be at least as large as the average number of sectors requested from the disk. If data tends to be requested sequentially, then it is a good idea for the page to be larger than the average request. By reading ahead of the actual requests, the cache is more likely to have the data when it is requested. The page size must be limited, however, because the larger the page, the smaller the number of pages in the cache.

Each time the disk is read, the cache checks the cache directory to see if the requested data is in the cache. When it is, this is considered a "hit." If the data is not in the cache, and the cache has to request it

## HIDDEN GOLD IN THE PS/2

If you're like me, the instructions are the last thing you look at when setting up a computer. IBM knows this and has simplified the setup of the new PS/2s. The wordless, poster-size drawings are, for the most part, self-explanatory. But if you tear through the box too quickly, you'll miss one of the nicest pieces of software IBM has produced. Literally hidden on the reference diskette provided with the computer is a program called IBM CACHE.COM. This program installs a disk cache on your PS/2 that dramatically improves the speed of the hard disk. To run the program, put the reference diskette into drive A: and enter A:\IBMCACHE. A menu-driven program guides you through the installation process.

There are a few differences between IBMCACHE and DCACHE. IBMCACHE is more flexible: it allows page sizes of 2, 4, or 8 sectors, as against DCACHE's fixed 8-sector page size. IBMCACHE installs itself as a device driver rather than as a terminate-and-stay-resident .COM file. IBMCACHE can use extended memory to hold the cache, but it cannot use expanded memory. DCACHE, on the other hand, can use expanded memory but not extended memory. Version 2 of IBMCACHE can support caching of diskette drives, while DCACHE caches only fixed disks. The last difference is availability. While DCACHE is available through PC Mag-Net, IBMCACHE is available only by buying an IBM PS/2.—Douglas Boling

from the disk, the request is considered a "miss." The performance of a cache is measured by the percentage of hits compared with the total number of accesses. This percentage is called the "hit rate" of the cache.

The most important question when designing a cache is what data should be kept there. These rules define the caching algorithm. I'll discuss three basic caching algorithms here—the associative, direct mapping, and set associative. In each case I'll give an example of how such a cache, with 16 pages of 8 sectors each, would be organized. The logical sector number for the example will be 16 bits wide.

**ASSOCIATIVE CACHES** The associative cache is the best performer in terms of hit rate. In an associative cache, data from the disk is stored anywhere there is a free page. Once the page is in the cache, the tag for that page is placed in the corresponding location in the cache directory. If there are no free pages in the cache, a page currently in the cache is replaced by the new page. DOS contains a small associative cache internally. This cache is explained in the sidebar "Buffers, DOS's Own Cache."

As shown in Figure 1A, in an associative cache the logical sector number is divided into the tag and the page index. The page index is the address of an individual sector within a page. The tag is composed of the bits of the logical sector number that are not included in the page index. When DOS requests data, the cache converts the logical sector number into a tag by discarding the four least significant bits. The cache then compares the new tag with each tag in the cache directory. That's because any page in the cache can contain any page from the disk. If the new tag matches a tag in the directory, the cache reads the data from the corresponding page in the cache. For example, if the tag matched the fourth tag in the directory, the data would be found in the fourth page in the cache. If the tag is not found in the cache directory, the cache overwrites a page currently in the cache and the old tag is replaced by the new tag.

The process of choosing which page to overwrite with new data is the most important consideration in designing an associative cache. Usually the cache replaces the

## BUFFERS, DOS'S OWN CACHE

**D**OS uses a small cache to keep the most recently used sectors in RAM. The size of this cache is set with the BUFFERS command in the CONFIG.SYS file. DOS uses associative caching with the least recently used replacement scheme and a page size of one sector.

The associative scheme used by the DOS cache is optimized for a small number of buffers. Using a large number of buffers improves the performance for random disk reads. However, it also degrades the performance of the associative cache for sequential reads. Prior to Version 3.3, DOS automatically set the number of buffers at two for PCs and three for AT machines. DOS 3.3 sets the number of buffers from 2 to 15, depending on the capacity of the disks and amount of RAM in the system. The DOS manual contains a good explanation of

the BUFFERS command.

Since DOS buffers are optimized for random reads and DCACHE is optimized for sequential reads, it would be nice if both could be used together. Unfortunately, using two caches together does little to improve the speed of the system. Since DOS typically reads data sequentially, however, you should notice improved disk speeds by using DCACHE rather than a large number of buffers. When using DCACHE you should reduce the number of buffers to three. Three buffers allow adequate performance for floppy disks (which are not cached by DCACHE), while freeing memory previously used by the buffers. Remember, if you are using DOS 3.3 you must specify BUFFERS=3 to ensure that DOS does not automatically allocate a larger number of buffers.

—Douglas Bollig

page that has not been used for the longest time. This is called the least recently used (LRU) algorithm. There are many other types of replacement algorithms, however, including some so complex that because of the time it takes them to compute, the cache is slower than just randomly replacing a page. The science of developing efficient replacement algorithms involves heavy mathematics, rather beyond the scope of this column. In general, however, the replacement algorithm is chosen only after carefully researching what types of requests the processor will be making of the disk.

While the associative cache is the best performer in terms of hit rate, it presents two problems in implementation. First, if it's large, the search for the corresponding tag in the cache directory takes a long time. Since this search must be made for each disk access, the overall performance of the cache is reduced. Second, the computation of the replacement algorithm can also take a long time. Even using the LRU algorithm described above, the task of keeping track of when each page was last used can chew up precious time, the very resource the cache is trying to save.

**DIRECT MAPPING CACHE** The direct mapping algorithm approaches the problem from a different angle. This algorithm uses part of the tag as an address to indicate what page of the cache can hold that particular page of data. The remaining bits of the tag not used in the address are used like the tag in the associative cache. Figure 1B shows how the logical sector number is divided into the page index, directory index, and tag. The tag contains the logical sector number, bits 8–15. The directory index is the address within the cache directory of the tag. For example, if DOS requests a read of logical sector 2357h, the cache will look in address 5 of the directory. If the tag is 23, the data for sectors 2350h–235Fh is stored in the fifth page of the cache. The cache then returns sector 7 of page 5 to DOS to satisfy the read request. If the tags do not match, the cache knows that the data is not in the cache since the directory index forces this particular sector to be in page 5 if it is in the cache at all.

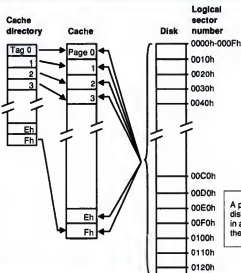
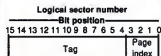
The limiting factor in a direct mapping cache is that a given sector can be stored in only a specific page of the cache. Because each page in the cache must be responsible for more than one page on the disk, it's



## ■ UTILITIES

## Associative Cache

Figure 1A



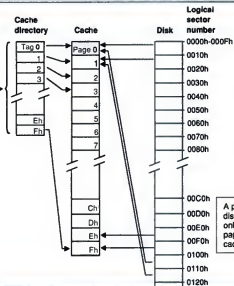
A page from the disk can be held in any page in the cache.



## Disk Caching Methodologies

## Direct Mapping Cache

Figure 1B

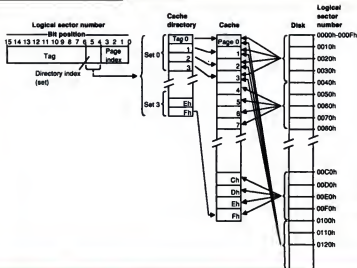


A page from the disk can be held only in a specific page in the cache.

**Figure 1:** Neither words nor pictures alone can fully describe the three disk caching methodologies. These illustrations will help you to visualize the different parts of a cache as you read through the text.

## Set Associative Cache

Figure 1C



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By James Lewis

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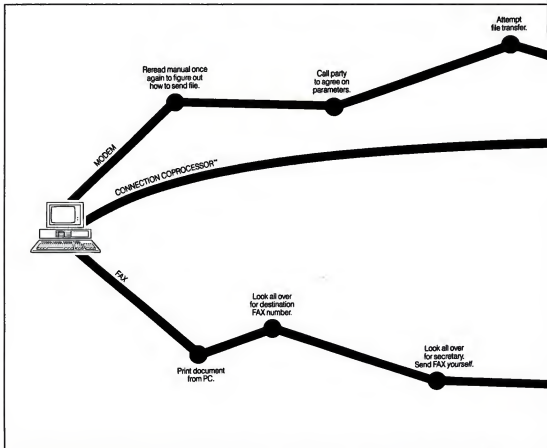
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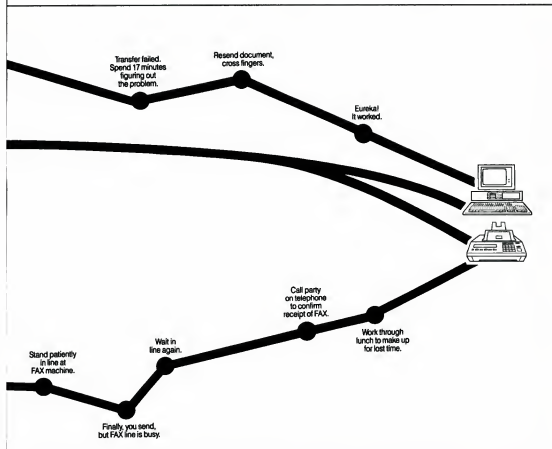
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## UTILITIES

```

END_READ:  DBC  DI                ;di holds the number of sectors
          DIV  MAX_SECTOR        ;to fact-.
          OR  CR,0               ;save the remainder (sector num)
          SET  LOCAL              ;since the sector number can not
          MOV  CR,MAX_SECTOR     ;be zero, check for this and
          AND  AA,0              ;correct if necessary.

SET_READ1:  DBC  DR,0            ;remove the remainder
          DIV  MAX_READ

;-----
;put cylinder and sector parameters into their proper registers.
          MOV  DR,0              ;move head to proper register.
          MOV  RCUR,AL,AX        ;PUT the cylinder number into the
          ROR  AL,1              ;strange, but required registers
          OR  CR,AX
          ROR  AL,1
          OR  CR,AX

;compute data buffer inside cache.
          MOV  DS,SI             ;point the data buffer for the
          MOV  AS,SEGMENT PTR     ;call to the proper cache page.
          ASUME  DS=NOTHING

;-----
;complete the parameters for the bio call.
          MOV  AH,01             ;get the number of sectors to read
          MOV  AL,01             ;read data from disk
          MOV  DL,DISK_NUM        ;access the correct disk

;set up parameters and call read bio int 13h.
          PUSH  AX
          PUSH  DI
          CALL  OLD_DISK_INT
          POP  SI
          JC  END_READ           ;if an error occurred, deal with it
          DC

;-----
;Cache hit. Transfer the data from the cache to the dos buffer.
CACH_HIT:  MOV  SI,CORRESPONDENT ;load seed with the dos data
          MOV  SI,DOSEFFECTIVE    ;buffer.
          ASUME  SI=NOTHING
          MOV  CX,WIN_OF_SECT     ;put number of words to transfer
          CLD                     ;into CR.
          MOV  SI,PAGE_PTR        ;load deal with the location of
          MOV  DS,SEGMENT PTR     ;the data in the cache.
          ASUME  DS=NOTHING
          CWD                     ;transfer the data from the cache
          RST  MOVSB              ;to caller.
          POP  CX
          POP  DI
          MOV  DI,CS:0000H        ;to the caller of int 13h

;-----
;return END configuration if necessary.
;return END configuration if necessary.
;-----
CALLER_EXIT_13:  MOV  SI,FLAG_0    ;check to see if we are using
          OR  CACHED_EXIT_13P     ;seg memory.
          MOV  AX,0000H
          MOV  DS,SEG_HANDLE       ;if so, restore the mapping
          INT  13H                 ;contact used before this
          OR  AX,AX                ;interrupt.
          JC  CALLER_EXIT_13P
          MOV  INT_13P_EXIT
          POP  DI
          POP  CX
          POP  AX
          POP  DI
          MOV  SI,AX,AX           ;clear ax to indicate a return
          MOV  SI,0000H           ;code.
          MOV  DI,0
          MOV  CX,0
          MOV  DX,0
          MOV  INT_13 3          ;clear carry to indicate an error.
          ;restore but keep current flags

;error routine
DISK_ERROR:  ASUME  DS=CODE
          MOV  AL,LOW_SEC_LOW     ;get logical sector, convert it
          MOV  DR,LOW_SEC_HIGH    ;into an index into the
          MOV  DI,LOWPTR+0000H     ;lookup table, then access the
          CALL  CHECK_HIT         ;flag.
          MOV  DI,PTR [DI][SI],0FFFFH ;see if we were reading 2
          MOV  CX,01              ;pages. If so, clear word
          MOV  SI,WIN_PTR         ;entry in the lookup table.
          MOV  DI,PTR [DI][SI],0FFFFH

;-----
;END_READ1:  MOV  LAST_READ_PAGE,AX
          MOV  AL,AX
          MOV  DL,DISK_NUM        ;reset disk system using
          PUSH  DI                ;bio int 13 function #.
          CALL  OLD_DISK_INT
          MOV  AH,INT_13P_EXIT
          RST  MOVSB

;-----
;END_Setup This routine saves the current state of the END driver, then
;loads in the proper END page needed for the cache.
;Entry:  dx = low word of logical sector number.
END_SETUP:  PROC  NEAR
          ASUME  DS=CODE
          PUSH  AX
          PUSH  DI
          MOV  CL,5
          MOV  SI,CL
          AND  AX,END_MAXK        ;convert logical sector num to
          ;a physical END page number.

;save current state of END driver
          MOV  AX,WIN_PTR
          MOV  CX,END_HANDLE
          INT  13H               ;call END driver

```

(DCACHE.ASM continues)

(DCACHE.ASM continued)

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```

Routine to print disassembled error messages.
=====
MEMORY_VECTOR:
MOV    DX,OFFSET MD3                ;PRINT DOB Memory vector
MOV    AX,9
TEST   SI,0
JNB    SI
MOV    AX,4*BXH
TEST   SI,0
JNB    SI
JMP     $                           ;terminate with rc = 2.

=====
;select disk drive to cache
DISK_SELECT PROC    HEX
MOV     DL,[DI]                    ;read number after /b
MOV     SI,0x1ff                   ;convert decimal number to binary
SHR     SI,SI,SHR_1                 ;allow only the numbers 0-9.
CWD     SI
JA      DSI2_SEL_ERR1              ;consider only /read disks
OR      DL,0x00
MOV     SI,BX,DL
CLC
RET
DSI2_SEL_ERR1:
MSG     DX,ERR_001                  ;illegal disk has been selected.
RTE
=====
;Expanded memory select
OSRM_SELECT PROC
;test if in EMS driver.
PUSH    SI
PUSH    DI
MOV     AX,1571E
TEST    SI,AX
JNB     SI                          ;Get EMS vector
MOV     SI,0x000
MOV     SI,SI*OFFSET_EMS_VECTOR    ;Compute the next 9 bytes with
; the expected user handle. If
; they are the same, allow use
; option, else, print error message.
PUSH    DI
PUSH    SI
MOV     AX,ERR_002
;Remember, proper registers done
; but change the flags
JMP     SI                          ;Indicate EMS option
;check for more commands
MSG     DX,OFFSET_HELP?
RTE
=====
;Expanded_Mem
OSRM

```

[illegible]



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## ■ UTILITIES

DCACHE intercepts calls to BIOS interrupt 13h, which is ultimately used by the PC to process all disk operations.

A resident program will consume less RAM if the nonresident code is made as functional as possible. In the case of DCACHE, the installation code is actually longer than its resident portion. The installation code checks for copies of DCACHE already in memory, processes the command line, provides short help messages, and, if necessary, installs the cache. The nonresident code can change the enabled flag of an already installed cache by replacing interrupt 13h and deallocating the memory. If DCACHE is executed after another copy of the code has already been installed, the new copy simply finds the installed code by searching for the copyright header of the installed copy.

The installation code has its own programming strategy to improve performance and use memory efficiently. The installation code is actually divided into two parts. The first part of the code handles all the functions that aren't needed when resident. The second part of the installation code, which is the resident part of DCACHE, is responsible for clearing the cache directory before DCACHE terminates. Since the cache directory begins at the end of the resident code, clearing the directory writes over the rest of the installation code for large cache sizes.

Since the cache directory can vary from 8 to 2048 bytes (depending on the size of the cache), DCACHE computes the size of the cache and releases all memory not needed for the cache size selected. It also releases the environment block to DOS to allow that memory to be used for other programs. The cache directory is aligned on a word boundary using the MASM EVEN pseudo-op. Since 16-bit processors like the 8086 and 80286 read memory one word at a time, aligning on a word boundary is important for improving performance when reading the cache directory. Note that I call the cache directory the "lookup table" in DCACHE.ASM.

If the cache is in DOS memory, the data cache is put in the very first segment after the cache directory, preventing a gap between DCACHE's resident code and the memory reserved for the cache. This is important because even if the memory in the

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## ■ UTILITIES

As a direct mapping cache, DCACHE divides the logical sector number into three fields. The first, the page index, is composed of the three least significant bits, which are used to find a particular sector within a page. The next field, the directory index field, varies from 2 to 11 bits wide, depending on the cache sizes selected. For a 16K cache, the directory index field uses only bits 4 and 5. For each bit increase in the width of this field, the size of the cache doubles. The last division, the tag field, is composed of bits 4-19, and because of the varying size of the index field the tag and directory index fields overlap. Having a fixed size for the tag field simplifies the code, and using 16 bits conveniently allows a cache directory size of one word for every page.

The use of 19 bits for the logical sector

■ I kept one inviolable principle in mind when designing DCACHE: the program must never compromise data integrity. Therefore, it is a write-through cache.

number puts an upper limit on the size of disk that DCACHE can handle. With a sector size of 512 bytes, the maximum size of the disk is 268,434,432 bytes. Since few users have disks larger than 260MB, this limitation is unlikely to be serious. To be safe, however, the initialization code determines the number of cylinders, heads, and sectors per cylinder for the disk selected and computes the largest logical sector number possible. If this maximum sector number is larger than 19 bits, installation is aborted.

DCACHE does not cache read requests larger than one page. The reason for this is twofold. First, since DOS seldom requests more than one sector at a time, there is little advantage in increasing the code size of

DCACHE to handle the few occasional large reads that occur. Second, a read request for a large number of sectors is probably a program load. Since a program is usually loaded only once during its execution, caching this read would not improve the speed of the disk.

I kept one inviolable principle in mind when designing DCACHE: the program must never compromise data integrity. To

ensure data integrity, DCACHE is a write-through cache. A write-through cache does not interfere with writes to the disk. DCACHE checks each write request to see if the sector is to be written in the cache. If the sector is in the cache, DCACHE will update the page in the cache, then pass the write request on to BIOS. If the number of sectors to be written is larger than a page, DCACHE erases the tags from the cache

## DISK ACCESS STATISTICS

To design a cache properly, how DOS interacts with the disk must be understood. To do this, I wrote a small program to intercept the BIOS 13h disk interrupt. The data from this program was instrumental in the design of DCACHE.

This data was recorded while the PC was performing the average tasks of editing files, running batch files, and compiling a few programs. Although the majority of users don't compile many programs, the process is similar to many other programs that manipulate files on a disk. The data from the BIOS intercept program shows quite clearly certain tendencies of DOS.

The first table in Figure A shows the typical number of sectors DOS requests from the hard disk. Note that an overwhelming percent of the time DOS requests only one sector. The reason for this is that DOS spends relatively little time moving programs into and out of memory. Most of the time DOS is reading or writing small chunks of data at the request of programs already in memory.

The second table in Figure A shows the relative displacement of two consecutive disk operations. To create this table, I computed the logical sector number for each disk access. The logical sector number is computed by numbering each sector from sector 1, head 0, cylinder 0, up to the last sector of the last cylinder. The displacement is computed by subtracting the logical sector number of the last disk access from the logical sector number of the current disk access. One of the interesting points of this data is that 55 percent of the time DOS reads or writes a sector within 8 sectors of the last disk access.

This predictability of disk accesses indicates that a disk cache will dramatically increase the effective speed of DOS.

—Douglas Boling

### DOS Disk Requests by Size and Location

Disk requests by size	
Sectors requested	Number of requests
1	4,176
2-7	6
8-15	0
16-32	10
33-64	6
65-128	12
Total	4,210

Disk requests by location	
Relative displacement of consecutive disk accesses	Occurrences
0	9
1	673
2-7	25
8-15	29
16-31	30
32-63	43
64-126	176
127 and greater	280
Total	1,265

Figure A: The data in these tables reveals the typical pattern of DOS disk operations. Overwhelmingly, data is requested in small parcels that tend to be adjacent.



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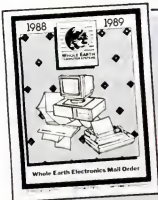
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DCACHE.COM is already compiled and ready to run. DCACHE.BAS will automatically create DCACHE.COM when run once in BASIC. DCACHE.ASM allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASH DCACHE;
LINK DCACHE;
EXE2BIN DCACHE DCACHE.COM
```

*Photocopy this page. Trim and hole-punch the copy and add it to your DOS manual.*



Douglas Boling

## Purpose:

A memory-resident hard disk cache that speeds disk Input/Output by holding recently accessed data in RAM, where it can be more quickly retrieved than by being read again from the hard disk.

## Format:

DCACHE [/OFF | /ON] [/U] [/Mx] [/E] [/Hx]

## Remarks:

When entered without any of its optional parameters, DCACHE installs and activates itself as a 64K conventional (DOS) memory cache for the primary hard disk drive in the system. The size of the cache, in kilobytes, can be varied by inclusion of the /Mx parameter, where x may be any one of the following values: 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, or 8192. Expanded memory that conforms to the Lotus/Intel/Microsoft expanded memory specification can be used in place of regular DOS memory by loading DCACHE with the optional /E parameter.

The /Hx parameter specifies which of two physical hard disks are to be cached: /H0 is the default primary drive and /H1 is the secondary drive. Note that a hard disk that is logically partitioned into several smaller drives is considered as a single drive by DCACHE. DCACHE cannot be set to cache floppy disk drives, but this need can be met by entering the BUFFER5=3 command as a line in the system's CONFIG.SYS.

After DCACHE has been installed, caching may be disabled or reenabled by issuing the DCACHE /OFF or DCACHE /ON commands. DCACHE /U uninstalls the program from memory if no subsequent terminate-stay-resident program has been loaded and if BIOS interrupt 13h has not been changed since DCACHE was installed.

DCACHE may be executed either from the DOS prompt or as a line in an AUTOEXEC.BAT file. The DCACHE syntax may be reviewed by entering DCACHE ? before or after loading the program. In the latter case, only the /OFF, /ON, and /U options will be displayed. In addition to the memory reserved for the cache itself, DCACHE occupies approximately 1,200 bytes of RAM.

## DCACHE Command

1988 No.17 (Utilities)



[illegible]

# dards.



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## ■ UTILITIES

directory without trying to update the cache. DCACHE never stops DOS from writing to the disk. This method is slower than other types of write caching but it is much safer.

For any operation other than a simple read, write, or check status, DCACHE resets the cache by clearing the cache directory. Again, it's better to err on the side of safety than to return incorrect data to DOS.

Error recovery is very important when a program inserts itself between DOS and BIOS. DCACHE uses a simple but effective technique to provide the necessary error recovery. If an error occurs during a disk read, DCACHE resets the disk system

using BIOS interrupt 13h function 0. The program then restores the original DOS calling parameters and jumps to the BIOS disk routine. This process allows DOS to detect any error in the read of a specific sector, while masking any error caused by the cache reading sectors not explicitly requested by DOS.

There is a potential problem with DCACHE causing repeated disk errors and resets. Assume that DOS requests a sector in a page that contains a bad sector. DCACHE would attempt to read the entire page, including the sector with the error. Since it is likely that DOS will request a sector within the same page on the next

read request, DCACHE might repeat the error each time the page is requested. To prevent this from happening, DCACHE stores the sector number of the last page that caused a BIOS error. If that page is requested again, DCACHE simply passes the request to BIOS without attempting to cache the page.

**EMS SUPPORT** The many features of the expanded memory specification made it quite easy for DCACHE to implement support of expanded memory. To use expanded memory, DCACHE must first determine if the expanded memory driver is present. To check for the driver,

## USING EXPANDED MEMORY

The Lotus/Intel/Microsoft expanded memory specification (EMS) has breathed new life into DOS. By using EMS a program can access up to 32MB of memory while still running under current versions of DOS. EMS is a paged memory system. Paged memory allows a large amount of memory to be used in small portions. Think of how you use a word processor—you can read only the current screen being displayed. To read data more than 25 lines away from the current position of the cursor, you must use the PgUp and PgDn keys to move the data you want to the screen. The same principle is at work in a paged memory system. Although you can't access all of the memory at once, by selecting individual pages you can use each page of memory separately.

EMS 4.0, the most recent version of the expanded memory specification, provides a dazzling array of functions for manipulating a paged memory system. This may at first seem intimidating, but fortunately only a few functions are needed for most programs.

To use expanded memory, a program must perform five basic functions. First, the program must determine if expanded memory is present and functioning. Second, the program must determine the address of the EMS page frame. Third, the program must reserve the EMS memory it needs. Fourth, the program must en-

able the page of EMS memory it wishes to use. Fifth, the program must deallocate its pages before it terminates. A resident program like DCACHE must add a sixth step: saving and restoring the state of the EMS driver.

Commands are issued to the expanded memory driver through interrupt 67h. As in DOS, individual functions are selected using register AH. However, the way EMS numbers its functions is confusing. Although they are numbered decimally from 1 to 30 in the EMS reference, the actual value passed in register AH ranges from 40h to 5Dh. Thus, to use function 7 (Get EMS Version), you must pass 46h in AH. (I will use the function number given in the EMS reference, not the actual hex value passed in AH.) The EMS driver returns the status of a command in AH. If, on return, AH is not zero, an error has occurred during the processing of the command.

There are two approved methods to test for the presence of the EMS driver. In the "open handle" technique, a program uses the Open Handle request function (3Dh). The register pair DS:DX points to the ASCII string EMMXXXXX0. If DOS does not return an error, you can assume that the EMS driver is present or there is a file on the current disk that has the same name. Using the handle obtained, call the Device Driver Control function (44h) with AL =

0. This returns information about a device driver. If bit 7 in DX is 1, call the Device Driver Control function again with AL = 7. This returns the output status of the driver. If AL = FFh, then the driver is present and available. Use Close File Handle function (3Eh) to close the expanded memory driver.

The second method to determine if the EMS driver is present involves checking the interrupt vector. The DOS Get Interrupt Vector function (35h) returns ES pointing to the segment of the EMS driver. A character device driver has a device name field at offset 0Ah of the segment. Compare the name of the driver at offset 0Ah with the ASCII string EMMXXXXX0. If the strings match, the driver is present. This technique is used by DCACHE.

Once a program determines that the EMS driver is present, it uses interrupt 67h subfunction 1, Get Status, to check the status of the driver. If AH returns a value other than zero, the driver is not functioning properly.

To get the address of the EMS page frame, use EMS function 2, Get Page Frame Address. The page frame is a 64K segment in memory where the EMS memory can be accessed, and the segment of the page frame is returned in BX.

Before a program can actually use expanded memory, it must determine if enough pages are available for its appli-

DCACHE reads the interrupt 67h vector in the interrupt table. If the segment points to a device driver with the label EMSXXX0, then the EMS driver is present. After determining that the driver is present, DCACHE uses interrupt 67h function 2 to get the address of the EMS page frame. DCACHE then uses interrupt 67h function 3 to see if there are enough EMS pages (each EMS page is 16K) to hold the cache. After verifying that there is enough EMS memory, DCACHE reserves the memory using interrupt 67h function 4. EMS function 4 also returns a handle used by the EMS driver to refer to the owner of a page of expanded memory. The handle is stored

so that it can be used by the cache routine to access the correct pages in EMS memory. The installation routine then loads the resident part of the cache routine into conventional DOS memory and terminates.

With EMS, as when using conventional DOS memory, DCACHE checks the cache directory to see if the sector requested is in the cache. (The cache directory is in conventional memory to save the time of accessing two EMS pages each time the cache is called.) If the read is a cache hit, interrupt 67h function 8 is used to save the current state of the EMS driver. DCACHE then uses interrupt 67h function 5 to map the EMS page with the correct cache page

into memory. From this point on, DCACHE proceeds as if the cache were in regular DOS memory. Before returning to DOS, DCACHE uses interrupt 67h function 9 to restore the page map to the state it was in before DCACHE was called. A more detailed look at the use of expanded memory is contained in the sidebar "Using Expanded Memory."

**PERFORMANCE** According to PC Labs' file access benchmark-test program, enabling DCACHE reduced the sequential read time for a file by 60 to 80 percent. Sequential write times were lowered by between 10 and 30 percent. Although DCACHE is a write-through cache, the savings are smaller because DOS must first read a sector before it can be written.

The time savings for random reads and writes of a file are dependent on the size of the cache. Testing with a 256K file and a record size of one sector (512 bytes) showed random read times for a 16K cache were reduced by 20 percent; write times were reduced by 5 percent. For a 64K cache, the times for random reads and writes were reduced by 40 percent and 15 percent, respectively. For a cache size of 256K, the random read times were reduced by 70 percent while the random write times were reduced by 25 percent.

The performance of DCACHE depends on how files are distributed on the disk, however. If the files are fragmented, DCACHE will not perform as well as if the files were tightly grouped. DCACHE performance can also be affected by the number of defective sectors on the disk. As the number of defective cylinders increases, the chances of DCACHE reading a bad sector and causing an error increases. DCACHE recovers from these errors, but they reduce the performance of the cache. In some cases, DCACHE may degrade the performance of file write times, though this degradation should be more than offset by the improvement in disk read times. Try it for yourself, with DCACHE turned off and on. If the feel of speed appeals to you, you'll leave it on. ☐

*Douglas Boling is an electrical engineer who has been involved in the design of computer hardware and software for 11 years.*

cation. To determine the number of free pages in the system use function 3, Get Unallocated Page Count. This function returns the number of unallocated pages in BX and the total number of EMS pages in DX.

To allocate pages of memory, use function 4, Allocate Pages. Call this function with BX equal to the number of pages being requested. The driver will return a handle in DX. This handle must be used in future calls to the EMS driver since it references the pages that have been reserved. The EMS 4.0 specification allows up to 255 handles, though not all EMS drivers support that many. Thus, a program must check the return code in AH to assure that all handles have not been used.

Function 5, Map/Unmap Handle Pages, allows the program to access the expanded memory it has reserved. Call function 5 with AL equal to the physical page number, BX equal to the logical page number, and DX equal to the handle of the calling program. The physical page is the page number in the EMS window, and can range from 0 through 3. Since the EMS window is 64K, four EMS pages can be accessed at any one time. The logical page number addresses a specific page assigned to the handle in DX. If a handle has been allocated five pages, then the pages would be addressed 0 through 4.

Before terminating, a program must release the pages it has been allocated. This is done by using function 6, Deallocate Pages. This gives future programs access to these pages. If a program terminates but remains resident, it is not required to release pages it still needs. It is important that a program with allocated pages trap the critical error handler and the Ctrl-break interrupts if these interrupts can occur during the program. If a program terminates under an error condition, it still must release its allocated pages.

Since terminate-and-stay-resident programs, interrupt service routines, and device drivers can be invoked at any time, the state of the EMS driver must be saved before these programs can use expanded memory. The EMS driver provides function 8 to save and function 9 to restore the state of the EMS page frame. Call function 8, Save Page Map, with DX equal to the handle of the program attempting to save the state of the driver. This is not the handle of the program being interrupted. Function 8 saves the current mapping of the EMS driver. This allows the interrupting program to remap the EMS window to access its own EMS pages. When the interrupting program is finished, it uses function 9, Restore Page Map. Like function 8, function 9 is called with DX equal to the handle of the interrupting program.—**Douglas Boling**

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# MICROSOFT'S OS/2 PROGRAMMING TOOLS



*Microsoft's new OS/2 Programmer's Toolkit for the OS/2 kernel is superior to IBM's. Its more-satisfactory macros are exemplified here in a handy PAUSEPOP program.*

Microsoft recently released its OS/2 Programmer's Toolkit, the company's \$350 answer to those who couldn't afford the \$3,000 cost of its earlier OS/2 Software Development Kit. The Programmer's Toolkit contains OS/2 programming tools, utilities, and documentation for 217 OS/2 1.0 function calls.

You use the OS/2 Programmer's Toolkit in conjunction with an OS/2 compiler or assembler. Microsoft has also released OS/2 versions of five language products: Macro Assembler 5.1, C 5.1, Pascal 4.0, FORTRAN 4.1, and BASIC 6.0. As of this writing (mid-June), I've seen all these languages except the new Pascal.

You don't need the OS/2 Programmer's Toolkit to write programs that run under OS/2 in a high-level language. If you stick to the facilities in the language for using files, writing to the screen, reading the keyboard, and so forth, you can compile the programs for either OS/2 or DOS. The language packages themselves include everything you need.

You don't even need the OS/2 Programmer's Toolkit to call OS/2 functions directly from your programs. Each language comes with its own set of include files or header files that give you access to the OS/2 functions. However, the language products do not contain OS/2 function call documentation. That's the primary purpose of the Programmer's Toolkit.

**THE OLD AND THE NEW** Microsoft's OS/2 Programmer's Toolkit comes 5 months after IBM released its own OS/2 Programmer's Toolkit (\$750) and OS/2

Technical Reference (\$250). (I discussed these in the June 14, 1988, Environments column.) Viewed simply, the Microsoft package is equivalent to the two IBM packages.

But it's not that simple. IBM offers free updates for OS/2 1.1; Microsoft will probably not. Some information in the IBM OS/2 Technical Reference (particularly on device drivers) is not included in the Microsoft Programmer's Toolkit. And the Microsoft package has an on-line Help system that is not available from IBM.

Overall, Microsoft's OS/2 Programmer's Toolkit is superior to the two IBM packages. Many of the problems I discussed earlier in connection with the IBM releases have been eliminated in the Microsoft package. (Instead, I have some brand-new complaints, which I'll discuss here.) The IBM OS/2 Technical Reference is very similar to material distributed earlier with Microsoft's OS/2 Software Development

Kit. The documentation has been cleaned up considerably for the Microsoft OS/2 Programmer's Toolkit, which now becomes the basic technical reference for OS/2 1.0.

## OS/2 PROGRAMMER'S TOOLKIT

Microsoft's OS/2 Programmer's Toolkit comprises two manuals and four high-density diskettes in both 5¼- and 3½-inch formats. The diskettes contain OS/2 programming utilities (including LINK, BIND, LIB, IMPLIB, and EXEHDR), C header files for OS/2 function calls and structures (also included in the C 5.1 package), the OS/2 1.0 import library DOSCALLS.LIB (also included with the OS/2 1.0 retail product), an on-line Help system, and 52 sample OS/2 programs.

The first of the two manuals is skimpy and contains a 75-page "Programmer's Learning Guide" (a discussion of OS/2 programming principles with most examples in C) and a 70-page "Programming Tools" manual, containing the documentation for various utilities and tools.

The second manual is the 580-page *Programmer's Reference*, with documentation for 217 function calls, including two not documented by IBM. IBM's OS/2 Technical Reference documents 221 function calls, including six not documented by Microsoft. Fortunately, in both cases, the omissions are not of great consequence.

The Microsoft documentation is heavily oriented toward the C programmer. All the function call syntax, structures, and examples are coded in C. Programmers working in other languages will have to fa-

■ Many of the problems I discussed earlier in connection with the IBM releases have been eliminated in the Microsoft package.

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miliarize themselves with C to translate the documentation into other languages. In contrast, the IBM OS/2 *Technical Reference* is oriented toward the assembly language programmer.

Annoyingly, the IBM OS/2 packages did not use the same structure names in their manual and C header files. The Microsoft documentation is almost entirely consistent with the C header files, though I did find one discrepancy in the declaration of the thread function passed to `DosCreateThread`.

Microsoft's documentation uses variable types (such as `SHORT`, `USHORT`, and `LONG`) that are defined in `typedef` statements in the C header files. IBM's C header files have nothing like this. Although these contrived data types may seem annoying at first, everything Microsoft has done in these OS/2 1.0 header files is consistent with what it's doing for the OS/2 Presentation Manager header files. It will help you to get accustomed to this before you approach Presentation Manager programming.

IBM's OS/2 *Technical Reference* failed to list the possible error codes returned from the functions; Microsoft's documentation contains some error codes, but not all. For example, calling most VIO (video I/O) functions from a detached process returns error number 465 (defined as `ERROR_VIO_DETACHED`). Yet this error is not listed among the VIO functions.

For the most part, the 52 sample programs included with the Programmer's Toolkit are written in C; a few modules in assembly language are supplied. The programs are generally short and illustrate individual OS/2 function calls.

One of these sample programs may look a little familiar to readers of this column. It's an early version of `WAKEUP` (Environments, December 22, 1987).

**C 5.1** Microsoft C 5.1 is an update of C 5.0. The package contains both OS/2 and DOS versions of the compiler and related tools. Header files with OS/2 structure definitions and function templates are included with C 5.1 as well as with the OS/2 Programmer's Toolkit.

You may recall that I have previously discussed (in the Environments column of March 29, 1988) some of the problems in-

volved with calling C library functions from a program that uses multiple threads. In a word, although some C library functions are reentrant, many of them are not. Thus, two threads that call the same C function could interfere with each other.

I mentioned in that column that Microsoft knew it would have to modify its C libraries for multiple threads. In C 5.1 it has done so, and the result looks pretty good. A special library called `LLIBCMT.LIB` includes "thread-aware" versions of all the C library functions. It's a large model library only. (Special header files are in-

---

■ Microsoft knew it would have to modify its C libraries for multiple threads. In C 5.1 it has done so, and the result looks pretty good.

---

cluded for the proper function declarations.) The documentation says that you can use it from a C program in any memory model, but this is not really true. It's safest to use these functions only from a large model program because the startup code expects `main` to be a far function and passes a far pointer to the command-line arguments to `main`.

In my earlier column, I also discussed the `rand` function as one C function that has problems when called from multiple threads. In this new multithread library, each thread that makes use of `rand` has its own independent pseudorandom sequence. This means that each thread will get the same pseudorandom sequence from `rand` unless it sets a different seed using `srand`. One easy way to ensure different seeds is to have the thread set the seed using its thread ID number.

Once you have a whole set of reentrant C library functions, however, why not go one step further and take the functions out of the individual C programs and put them into a dynamic link library? Then every C

program that shares this dynamic link library would not need to include any code for the C library functions.

The C 5.1 package doesn't contain this dynamic link library, but it contains everything you need to create it (including a `.CMD` file) and instructions. If you follow these instructions, the resultant dynamic link library is called `CRTLIB.DLL`. (CRT in this context stands for "C runtime" rather than "cathode ray tube.")

Although you can certainly use this `CRTLIB.DLL` file with your own programs, it's not quite ready for prime time. One problem is that dynamic link libraries that make use of `CRTLIB.DLL` cannot contain their own initialization code. I expect that C 6.0 will contain a better approach to putting C library functions in a dynamic link library. Consider `CRTLIB.DLL` a taste of things to come.

All of the information about multithread functions and `CRTLIB.DLL` is tucked away in a disk file called `MTDYNA.DOC`. This is one of 16 documentation files (occupying a total of 260K) included on the C 5.1 diskettes. All these documentation files constitute a real nuisance. Obviously a small `README` file is sometimes necessary to list late-breaking changes and bugs. But with C 5.1, these files form an important part of the documentation. This is not what we would have expected from a company of Microsoft's size and standing.

It would have been nice if the C 5.1 package also contained an OS/2 version of `QuickC`, but no such luck. `QuickC` has not been ported to OS/2, and neither has the graphics library included with C 5.0.

### INCOMPATIBLE SOURCE CODE

IBM and Microsoft have gone to great lengths to assure everyone that users will encounter no differences in the execution of OS/2 applications under IBM OS/2 or one of the versions of MS-OS/2 sold by other manufacturers. Obviously, the compatibility among various versions of OS/2 is crucial for users.

Programmers are not so lucky, however. C programs that call OS/2 functions are generally not source code compatible between IBM's C/2 and Microsoft's C 5.1. This incompatibility results from the different header files.

For example, to read a key from the keyboard, an OS/2 program uses the KbdCharIn function. In IBM's SUBCALLS.H file, the function is declared

```
extern unsigned far pascal KBDCHARIN (
    struct KeyData far *, unsigned, unsigned);
```

This function requires a pointer to a structure of type KeyData. The KeyData structure is defined like this:

```
struct KeyData {
    unsigned char char_code ;
    unsigned char scan_code ;
    unsigned char status ;
    unsigned char nla_shift ;
    unsigned shift_state ;
    unsigned long time ;
};
```

The code to obtain a keystroke is

```
struct KeyData kd ;
....
KBDCHARIN (&kd, 0, 0);
```

In the Microsoft header file organization the KbdCharIn function is declared in BSESUB.H

```
USHORT APIENTRY KbdCharIn (
    PKBDKEYINFO, USHORT, HKBD);
```

Notice that the function name uses a mixture of uppercase and lowercase letters. The words USHORT, APIENTRY, PKBDKEYINFO, and HKBD are all identifiers defined with typedef or #define statements. Here are the two typedef statements that define the structure and a far pointer to the structure:

```
typedef struct KBDKEYINFO {
    UCHAR chbchr ;
    UCHAR chbcan ;
    UCHAR fdbstat ;
    USHORT bntshft ;
    USHORT fdbstat ;
    ULONG time ;
} KBDKEYINFO ;
typedef KBDKEYINFO far *PKBDKEYINFO ;
```

The call to KbdCharIn in a program for Microsoft C 5.1 looks like this:

```
KBDKEYINFO kbci ;
....
KbdCharIn (&kbci, IO_WAIT, 0);
```

The IO\_WAIT identifier is defined in BSESUB.H to be 0.

The Microsoft header files define several macros that can make your OS/2 C programming a little easier. For example, suppose a thread needs to find its thread ID. Using IBM C/2 and the IBM header

files, you need to define three variables, thus:

```
unsigned int segGlobal, segLocal, tid ;
```

You call DosGetInfoSeg, then convert the selector to the local information segment into a far pointer that addresses the integer 6 bytes from the beginning (the thread ID).

```
DOSGETINFOSEG (&segGlobal, &segLocal);
tid = * (unsigned int far *)
        ((long) segLocal << 16 + 6);
```

With Microsoft C 5.1, the MAKEP macro converts a selector and offset into a far pointer. You then cast that to a pointer of type PLINFOSEG (pointer to local information segment) and access the tidCurrent field of the structure:

```
SEL segGlobal, segLocal ;
TID tid ;
....
DOSGETINFOSEG (&segGlobal, &segLocal);
tid = ((PLINFOSEG)
        MAKEP (segLocal, 0))->tidCurrent ;
```

I find the Microsoft code a little clearer.

When you think about it, the differences between the IBM and Microsoft header files are a little scary: IBM and Microsoft are supposed to be working together in developing OS/2, yet they can't even manage to release OS/2 1.0 programming tools with similar C header files. Let's hope they manage to get their acts together for OS/2 1.1.

For OS/2 C programs shown in this column, I'll be using the Microsoft C 5.1 compiler and header files. This compiler is more recent than IBM's (which is essentially a protected-mode version of Microsoft C 4.0), and the header files are consistent with what Microsoft is doing for the OS/2 Presentation Manager.

**CODEVIEW AND AN EDITOR** All of Microsoft's new language products include OS/2 and DOS versions of the CodeView debugger as well as OS/2 and DOS versions of a programmer's editor called the *Microsoft Editor*.

CodeView has generally received good reviews in the computer press (mostly because it's so much better than SYMDEB, Microsoft's previous debugger), but I've always found CodeView to be annoyingly cranky. For example, you can view your program in a "mixed" mode where you see both your original source code and the assembly language. That's very nice. But

if a source code statement extends over more than one line, you see only the last line of it.

Continuing this tradition, the new CodeView allows you to view C structures. It lists all the structure fields and their current values. That's great. But if you view this structure in a watch window, CodeView uses only one line to show you this information. If your structure has more than four or five fields, you don't see the later fields. (You can view the entire structure in a dialog box if you wish, but you can't do anything else in CodeView while the dialog box is displayed.)

The new CodeView lets you debug a multithreaded program. Again, that's great. But when you use the T command to trace through source code that is shared by more than one thread, you can easily end up in a different thread than the one you thought you were tracing.

I've been using the *Microsoft Editor* for a couple of weeks and haven't yet mastered the strange command structure. It's flexible—you can reassign all the command key combinations if you want, and you can even write extensions to it in C, so a patient user can customize it.

The big problem is that the *Microsoft Editor* writes directly to the screen. While this is common and accepted in DOS programs, it's unnecessary in OS/2 because the VIO functions are very fast. Moreover, in some versions of OS/2, if you switch away to another session and then switch back to the *Microsoft Editor* session, the screen returns blank. True, this is a bug in OS/2 rather than in the editor. But if the editor had used VIO calls, it wouldn't be a problem.

Officially, Microsoft recommends that character-mode OS/2 programs use VIO rather than write directly to the screen. Yet, other software manufacturers are usually more interested in what Microsoft *does* than in what it *says*. And what Microsoft has done in its editor is to set a very bad example that I hope no other software manufacturer imitates. (I'm told that a future version of the editor will use VIO calls.)

**MASM 5.1** Microsoft's Macro Assembler 5.1 is an update of the Macro Assembler 5.0. A small update manual (plus five



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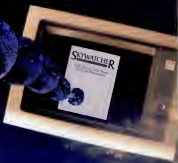
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documentation files that occupy a total of 105K of disk space) describe the enhancements.

Your faith in the accuracy of the update manual is sure to be shaken, however, when you come to the section (on page 13) entitled "For Further Reading." It says: "You may also want to see 'Environments,' a column in *PC World* by Charles Petzold." I think not. Fortunately, the remainder of the manual is much more accurate.

One of the more interesting enhancements involves an extension to the `PROC` statement. This new facility lets you define names for variables passed to the procedure on the stack and tell the assembler what high-level language put them there. You can then reference these variables by name rather than by an offset to BP. You can also define local variables within pro-

cedures that are stored on the stack. As assembly language is used less for major applications and more for coding small and fast subroutines that are called from a high-level language, these enhancements are very useful. I'll show how to use some of them in the next issue.

The Macro Assembler 5.1 package also contains "include" files that define OS/2 structures, useful constants, and macros to call the OS/2 functions. (These include files are described in—where else?—a documentation file.) Compared with the include files in IBM's Macro Assembler/2 package . . . well, there is no comparison. Microsoft's are intelligent macros that generate very good code.

Unfortunately, my first assembly language program attempt to try out these new macros used the `KbdSetStatus` function and the `KBDINFO` structure. I wasted

a lot of time before realizing that Microsoft had incorrectly defined the KBDINFO structure in BSESUB.INC. The first four fields are defined there as db (byte) rather than dw (word).

Call me picky, but I feel that include files should be 100 percent correct. Still, these macros are too good to ignore, so let's examine how they look in a real program.

### THE PAUSEPOP PROGRAM

PAUSEPOP program in Figure 1 shows how the new OS/2 function call macros are used in an assembly language program. The statement at the top

```
INCLUDE OS2.INC
```

includes the main OS/2 file, which in turn includes other files (OS2DEF.INC, BSE.INC, BSEDOS.INC, BSESUB

```

;-----
; PAPERPOP.ASM -- WOFFICE what detached OS/2 program is terminated
; (c) 1988, Kliff Communications Co.
; PC Magazine - Charles Petzold, 8/88
;-----

        .386

INCLUDE OSL.INC

DOSSEG
.MODEL     SMALL
.STACK    65536

        .DATA
;-----
; Initialised Data Segment
;-----

db      "PAPERPOP (c) 1988, Kliff Communications Co."
; "PC Magazine ", 254, "Charles Petzold, 8/88"

PopUpFlag dw VP_WAIT or VP_TRANSPARENT

PauseMsg db 201, 70 dup (" "), 187
          db 169, 70 dup (" "), 186
          db 168, " PAPERPOP:"
          db 167, 70 dup (" "), 188
          db 169, 70 dup (" "), 186
          db 159, 70 dup (" "), 182
          db 169, " Press Enter to continue.", 53 dup (" "), 186
          db 200, 70 dup (" "), 180

Attribute1 db 176
Attribute2 db 70h

vloci      VLOCUSORINFO <N, #, #, ->
kbel       KBOREINFO <>

        .CODE
;-----
; Code Segment
;-----

;-----
; Parase command line to get text string
;-----

Entry:    mov     BX, AX
           ; Environment selector

SkipProgName: mov AL, DS:[BX]
              inc  BX
              or   CX, AL
              jnz  skipProgName
           ; Check if it's zero
           ; If so, continue

SkipSpaces: mov AL, ES:[BX]
              inc  BX
              or   AL, AL
              jnz  finishMsg
           ; Get a byte
           ; Kick up the pointer
           ; See if end of parameter
           ; If so, store CX

cmp AL, ' '
jnz SkipSpaces
           ; See if it's a space
           ; If so, try another

mov     CX, 0
mov     DI, Offset InStrMsg
           ; Max number of characters
           ; Destination of message

Transfer: mov [DI], AL
           inc  DI
           ; Store byte in message
           ; Increment pointer

         mov AL, ES:[BX]
         inc  BX
         or   AL, AL
         loopne Transfer
           ; Get next byte
           ; Kick up source pointer
           ; See if it's zero
           ; Continue if not zero

FinishMsg:
           ; Pop up on clear screen (always ES by 25) and display text strings
           ;-----

VfpPopUp PopUpFlag, #
           ; Try pop up transparently

or  AX, AX
jc  PoppedUp
           ; Check error code
           ; Continue if no error

mov [PopUpFlag], VP_WAIT or VP_OPAQUE

VfpPopUp PopUpFlag, #
           ; Pop up opaquely

PoppedUp: mov CX, 7
          sub DX, DX
          sub SI, SI
           ; Number of lines
           ; Row number
           ; Effect in Pausing

LineLoop: VfpWriteCharStart PauseMsg[SI], #, DE, #, Attribute1, #
          inc  DI
          add  SI, 8
          loop LineLoop
           ; Set row
           ; Set line in message

VfpWriteAttr Attribute2, 24, 3, 2, #
VfpSetColor vloci, #
VfpBeep 250, 250
           ; Hide cursor
           ; Alert user

;-----
; Wait for keystroke and then terminate
;-----

ExitBuf:  @BdFlushBuffer #
           ; Flush keyboard buffer

CheckKey: @BdCharIn kbel, -> WAIT, #
          jmp [kbel.kbel_chchar], 13
          jmp CheckKey
           ; Wait for keystroke
           ; If not, get another key

@BdEndPopUp #
           ; End the popup

@OsdExit EXIT PROCEDURE, #
           ; Exit program

END Entry
```

**Figure 1:** *PAUSEPOP.ASM* is similar to the OS/2 *PAUSE* command but displays the message "Press Enter to continue" in a pop-up screen.

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.INC, and BSEERR.INC). The VIOCURLSORINFO and KBDKEYINFO structures used in the DATA section of the program are defined in BSESUB.INC. The macros for the individual functions (beginning with @) are defined in BSEDOS.INC and BSESUB.INC.

You can compile and link this program with the Microsoft Macro Assembler 5.1 by running

```
MASK PAUSEPOP;
LINK PAUSEPOP, /ALIGN:16, WUL, DOSCALLS;
```

The general syntax of PAUSEPOP is

**PAUSEPOP [message]**

PAUSEPOP is somewhat like the OS/2 (and DOS) PAUSE command used in batch files. As you know, PAUSE temporarily suspends execution of the batch file and displays the message "Press any key when ready." PAUSEPOP displays the message "Press Enter to continue" (as well as the optional message passed as a parameter to PAUSEPOP), but it does so only after calling the OS/2 VioPopUp function. The use of VioPopUp allows PAUSEPOP to run as a detached process and inform you when other detached processes have terminated.

**SOME EXAMPLES** Running PAUSEPOP by itself on the OS/2 command line is not very interesting, but try it anyway:

**PAUSEPOP** This is a message

The pop-up screen displays the message "This is a message" in the upper part of the screen. When you press Enter, you return to the command line.

You can also run PAUSEPOP as a detached process:

**DETACH PAUSEPOP** Another message

In this case CMD.EXE will display the process ID and the command-line prompt before PAUSEPOP displays its message.

PAUSEPOP is most useful when detaching other programs. For example, on a single line, enter

```
DETACH CHKDSK >CHKDSK.OUT & PAUSEPOP
Chkdsk is finished
```

The DETACH command affects both CHKDSK and PAUSEPOP. The ampersand (&) between the two commands tells

OS/2 to run PAUSEPOP after CHKDSK is finished. When PAUSEPOP eventually is executed, you can be in the same session, another OS/2 session, or even in the DOS compatibility mode session. PAUSEPOP still displays the message "Chkdsk is finished." When you press Enter you return to where you were at the interruption. You can then look at the CHKDSK.OUT file at your convenience.

You can generalize this procedure using the batch file called NOTIFY.CMD, shown in Figure 2. NOTIFY runs both the

Figures 3 and 4. To begin, you put a diskette in drive A: and run

### FBOX

The command-line prompt will appear and you can go on to something else. When you get a pop-up screen from PAUSEPOP you take the formatted diskette out, put a new one in, and press Enter. Output from FORMAT is stored in OUTPUT.TMP so you can look at it later and then delete the file. (OUTPUT.TMP collects about 40K of output, so you will wish to delete it.)

```
@REM -----
@REM NOTIFY.CMD for use with PAUSEPOP.EXE
@REM -----
@DETACH %1 %2 %3 %4 %5 %6 %7 %8 %9 & PAUSEPOP %1 is finished
```

**Figure 2:** You can use NOTIFY.CMD rather than DETACH to notify you when a detached program has completed execution.

program indicated on its command line (with possible parameters) and PAUSEPOP as detached processes. You use NOTIFY with CHKDSK like this:

**NOTIFY CHKDSK >CHKDSK.OUT**

Here's an example where PAUSEPOP comes in handy. Suppose you want to format a box of ten high-density diskettes, but you would rather be doing something else on the PC while the diskettes were being formatted. You want to be interrupted only when it's time to put a new diskette in drive A:. You can do this using the FBOX.CMD and FBOX2.CMD batch files shown in

FBOX.CMD simply executes FBOX2.CMD ten times in a DETACHED FOR command. Because FORMAT requires some keyboard input (two carriage returns and an N when FORMAT asks whether to format another diskette), FBOX2.CMD executes a few ECHO commands to construct that input in INPUT.TMP. After FORMAT finishes, INPUT.TMP is deleted and PAUSEPOP notifies you to insert a new diskette.

**SESSIONS AND PROCESSES** As you know, OS/2 1.0 supports up to 12 protected-mode sessions, each of which is associ-

```
@REM -----
@REM FBOX.CMD -- Formats a box of high-density diskettes
@REM -----
DETACH FOR %X IN (1 2 3 4 5 6 7 8 9 10) DO FBOX2 %X
```

**Figure 3:** FBOX.CMD uses PAUSEPOP to format a box of high-density diskettes in the background and interrupts you only when it's time to put in a new diskette.

```
@REM -----
@REM FBOX2.CMD -- Run from FBOX.CMD to format diskettes
@REM -----
ECHO. >INPUT.TMP
ECHO. >>INPUT.TMP
ECHO N >>INPUT.TMP
FORMAT A: <INPUT.TMP >>OUTPUT.TMP
DEL INPUT.TMP
IF NOT %1==10 PAUSEPOP Diskette %1 done. Insert next diskette.
IF %1==10 PAUSEPOP Finished formatting diskettes.
```

**Figure 4:** FBOX2.CMD is executed by FBOX.CMD to run FORMAT and PAUSEPOP.

ated with a virtual screen and a virtual keyboard buffer. At any one time, one session is in the foreground and the rest are in the background.

Most processes that run under OS/2 are associated with a particular session. When a process writes to the screen, it's actually writing to the virtual screen associated with that session. If the session is in the foreground, the virtual screen is the real video display. Otherwise, the display out-

■ Except VioPopUp, all OS/2 functions with the prefix Vio, Kbd, or Mou return error codes if run from a detached program.

put from the process is stored in memory until the session is switched to the foreground.

Detached processes (including processes started from RUN statements in the CONFIG.SYS file) are not associated with any session. That means they do not normally get access to the screen and the keyboard. With one exception, all the OS/2 functions beginning with the prefix Vio (video I/O), Kbd (keyboard), or Mou (mouse) return error codes if run from a detached program.

That exception is the important VioPopUp function. A detached program uses VioPopUp to get access to the screen and to read keyboard and mouse input. The program must then execute VioEndPopUp to return the system to normal.

In the usual case, the VioPopUp function saves the contents of the current screen, switches to a video text mode (25 80-column rows), clears the screen, and positions the cursor at the upper-left corner. The VioEndPopUp function restores the contents of the screen from the session interrupted by the VioPopUp call.

The pop-up facility is intended to let detached programs (or any program running in a background session) display a message to the user and get a quick response.

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## ■ ENVIRONMENTS

A pop-up screen should not require long-term viewing.

There are some severe restrictions on the use of pop-ups. Only one process can have a pop-up screen active at any time.

Calls to the VioPopUp function cannot be nested. While the pop-up screen is active the user cannot switch to the Program Selector or to another session. And although most OS/2 functions are allowed during a

pop-up, some (particularly those that would affect the video mode) are not.

**POP-UP OPTIONS** The first parameter of the VioPopUp function is an address of a 16-bit flag word that specifies some pop-up options. All the bits of this word must be set to 0 except the lowest 2 bits.

■ The problem with requesting transparent operation is that OS/2 does not support it in all cases.

You set the lowest bit to 1 if you want the VioPopUp function to wait until a pop-up is available. A pop-up is unavailable, for example, if another process currently has a pop-up active. For instance, the HARDERR.EXE program in OS/2 is responsible for displaying an "abort, retry, ignore, fail" message in a pop-up screen. If that pop-up is active, another program that wished to use a pop-up must wait until HARDERR's pop-up is ended.

OS/2 programs usually set the lowest bit of the VioPopUp flag word to 1 because there is probably not much the program can do if the pop-up is not immediately available. If the lowest bit of the flag word is 0, then the program must check for an error code of 406 (called ERROR\_VIO\_EXISTING\_POPUP) when the VioPopUp function returns.

If you use the OS/2 include files (as does PAUSEPOP), you can use the constants VP\_WAIT or VP\_NOWAIT to set this bit to 1 or 0, respectively. Using these constants makes your program obviously easier to read and understand.

You can set the next-to-lowest bit to 1 for "transparent operation." When using the OS/2 include files, the constant VP\_TRANSPARENT sets this bit to 1 and VP\_OPAQUE sets it to 0. In transparent operation, OS/2 will usually not change the video mode or clear the display if the current session is in a text mode at the time



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the program calls VioPopUp. The program can then write over part of the existing screen or read the contents of the screen.

But keep in mind that this pop-up screen is merely a copy of the foreground session screen at the time VioPopUp was called. Although a program in the interrupted session will continue to run and write to the display, the pop-up screen will not reflect that new screen output. The process that calls VioPopUp does not have to save the contents of this screen—the interrupted session's screen will be restored normally during the call to the VioEndPopUp function.

PAUSEPOP (like the OS/2 SPOOL program) attempts to use transparent operation first. Because transparent operation does not clear the display, it's less of a jolt when the pop-up is displayed.

The problem with requesting transparent operation is that OS/2 does not support it in all cases. If the screen is in a graphics mode or if the foreground process is altering video adapter registers directly, then VioPopUp will fail with an error code of

483 (ERROR\_VIO\_TRANSPARENT\_POPUP).

In this case, PAUSEPOP calls VioPopUp using opaque mode. This clears the screen before PAUSEPOP displays the message.

#### MACRO EASE AND FLEXIBILITY

PAUSEPOP makes ten calls to OS/2 functions, yet each call requires only one line in the PAUSEPOP.ASM source code file. The parameters follow the function name in the same order that they would in a high-level language such as C.

You'll notice that the parameters of these macros can be registers (such as DX), constants (0 and EXIT\_PROCESS), addresses (Attribute1), or indexed addresses (PauseMsg[SI]). The macros defined in the include files are quite complex and can recognize these data types and generate error messages if the parameters are not complex. The macros even take account of the .286 assembler directive to generate 80286 code rather than 8086 code. With a few exceptions, the generated code is identical to what you'd use yourself.

In short, these are macros you can use without being ashamed of the results. ☐



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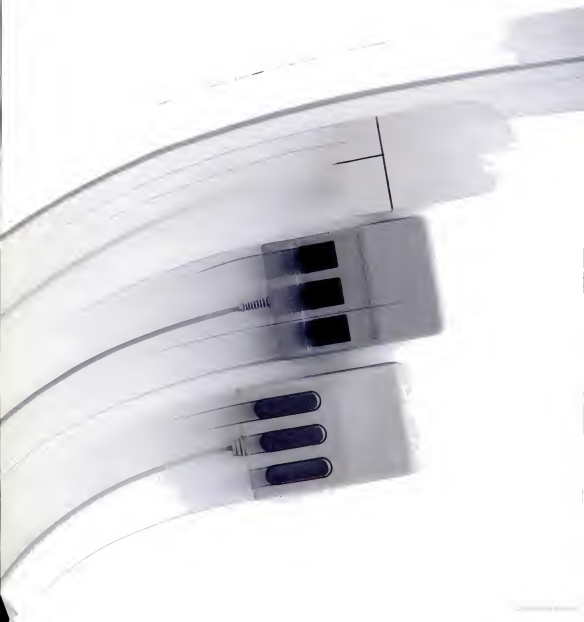
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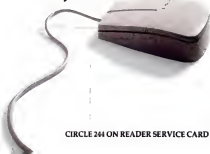
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## ■ POWER PROGRAMMING ■ RAY DUNCAN

# KEEPING IN TOUCH WITH THE READERS



*Now that we've examined time and date formatting, qualifying filenames, and sorting, it's time to look into the mailbox for some of your corrections and comments.*

## Modifying our time and date routines to work with Turbo C

I'm having trouble with the TD.C and TRYTD.C programs presented in your May 17, 1988, column. I am using Turbo C, Version 1.5, and I cannot seem to link the two files TD.C and TRYTD.C into an executable file. Incidentally, both files compile into object files with no errors! What am I doing wrong?—*Jim White (electronic mail)*

Your "problem" is my fault. Both programs, TD.C and TRYTD.C, contain the source code line

```
union REGS regs;
```

which declares a data structure of type REGS with the name regs. Data structures not declared inside a procedure are public by default—that is, they are available for reference by code in other object modules. The result in this case is duplicate symbols in two different object files, so the Turbo C Linker quite properly complains.

I originally tested the routines in TD.C and TRYTD.C as a single file before breaking them into two files for publication. Just before sending in the column, I compiled and linked TRYTD.C and TD.C as independent modules with Microsoft C, but I failed to do the same with Turbo C. Naturally, I got bitten by Murphy's Law once again.

To fix the problem, you can either instantiate one of the REGS structures with some other name, thus eliminating the

name collision, or declare one or both of the REGS structures as static, thus limiting its "visibility" to the module in which it appears.

## Additional information about the QFN program

When I first saw your article about "qualified file names" (July 1988), I was amazed how simple QFN is compared with what I had hacked together in Pascal to achieve the same purpose. Unfortunately, however, QFN doesn't always work reliably as written.

First, QFN fails with the simple "... " or "...", which are both legal constructs under DOS. Also, try "DIR ...". Second, QFN returns inconsistent formats. If you have a C:\ASM directory, entering C:\ASM and C:\ASM\ do not return the same string. QFN also fails with the null string, which under DOS signifies the current drive and directory. And last, QFN doesn't address the cases of an empty floppy disk drive or an unformatted disk. True, this is a "critical error," but as far as the naive user is concerned, the program using QFN bombs.

The user should be allowed to enter any DOS legal filespec, as well as only partial specs of drive/path (with a default filename supplied by the calling program). QFN should accept partial specs with and without a trailing backslash character. In other words, it should be smart enough to distinguish between potential filenames and a trailing directory without a trailing

slash. It obviously should also gracefully (and quickly) recover from a critical error, such as an empty drive.—*Peter Baenziger (electronic mail)*

My vision through the retrospectoscope is always a lot sharper than it is at magazine deadline time, and I see upon rereading the column in question that I failed to make some of my intentions entirely clear.

The QFN.ASM routine regards any string that does not terminate with a character as a potential filename. Partial or complete paths without a filename should always be indicated with a trailing \ character. In either case, the target directory must already exist, although the file need not exist (so that fully qualified names of files can be built and displayed to the user for confirmation before the actual file is created). As a result, TRYQFN rejects "C:..." because "... " is not a valid filename. However, it works fine with entries such as "C:.\ ".

As for the null string problem, QFN.ASM is intended for use with MASM programs rather than C programs. If you feed QFN.ASM a string with zero length, it (properly, I feel) returns a string containing the current drive and directory. However, it does not (and was not intended to) handle a "null string" in the C sense of a 1-byte-long string consisting only of a zero byte.

In my opinion, critical error handling does not properly belong in a special-purpose routine such as QFN.ASM but should be a general property of an application program.

## ■ POWER PROGRAMMING

### Modifications of ARGV.ASM and ARGC.ASM are now available

Since I had been interested in writing similar routines for some time, I was ecstatic when I saw your ARGV.ASM and ARGC.ASM routines (December 22, 1987). After examining the code more closely, however, I realized that the procedures published would not properly process arguments in quotes or expand wildcards in the manner of the C library equivalents.

To make a long story short, I decided to modify the ARGC.ASM and ARGV.ASM routines to handle quoted strings properly, and I wrote two new procedures, WCC.ASM and WCV.ASM, to handle wildcard filename expansion. ARGC was further modified to parse command-line switches. I have enclosed the source code for these files as well as a demo program, SA3.ASM, which is a modified version of the SHOWARGS.ASM program presented in the article.—Paul Eymard; Galliano, Louisiana

Many thanks to Paul Eymard for these fine routines. Additional improved versions of ARGC.ASM and ARGV.ASM—modified to handle quoted strings and delimiters other than spaces and tabs—were also submitted by Tom Gilbert of Kansas City, Kansas, and by Robert Brasfield of Seattle, Washington. I will make all of these alternative versions available for downloading on PC MagNet.

### Confusion about macro assembler terminology

Just as Kleenex and Xerox are not the only brands in their respective categories, Microsoft's Macro Assembler is not the only qualified assembler available today. To be fair, a phrase like "Discussions concerning development work in C and MASM" should instead read "Discussions concerning development work in C and assembler." Since SLR Systems has developed OPTASM, "MASM" should be used only when you are actually discussing it as a specific product. OPTASM is also an MS-DOS assembler for the 8086/80286 family of processors, and is an improved

alternative to Microsoft MASM.—Alyson Krchnavy; SLR Systems, Butler, Pennsylvania

I have a copy of OPTASM and have found it a very fast, sound product with good documentation and excellent upward compatibility from Microsoft MASM 5.0. The days when Microsoft MASM was the only game in town for assembly language programmers are gone for good. In future columns, I'll try to avoid confusing macro assemblers in general with the Microsoft MASM product, and will test all published code with OPTASM as well.

[The term "MASM" is an acronym for "macro assembler" and is not a trademark or product name. As such, it embraces the IBM, Microsoft, SLR, and other macro assemblers without distinction.—Ed.]

### On resisting the urge to update to Microsoft MASM

In your column of April 26, 1988, you advised Mr. John Intorcio to "update that rascal [Microsoft MASM] as soon as possible!" As reasoning for this recommendation, you argued that current versions are several times faster and more powerful, that the documentation has improved immensely, and that MASM 5.0 comes with CodeView. I don't disagree with your observations, although I do disagree with your advice.

The primary functions of an assembler are the same today as they were when I wrote my first assembly language program over 20 years ago; namely, to convert mnemonics into machine instructions on a one-for-one basis, to set aside and (optionally) initialize data areas, and to permit symbolic address references. Since Mr. Intorcio's MASM Version 1.25 presumably already performs these functions, we can assume that it will, as he said, "work for the preliminaries."

When should one spend a hundred bucks or so for a new assembler? The answer is, when it can give a hundred bucks or so of productivity improvement. Most of our time as programmers (at least in the micro environment) is (or should be) spent in analysis and design, a lot of time in cod-

ing, and some more time in debugging. Only a nit of our time is spent waiting for the assembler/compiler to finish. By way of example, I assembled a program of 771 lines (including comment-only lines) to/ from RAMdisk in just under 9 seconds with my Version 2.0 Microsoft MASM. Even if a later assembler version could assemble instantly, the most I could recover is less than 9 seconds.

So far as better documentation is concerned, I haven't read the manuals that go with the later versions of the assembler (for that matter I haven't read through the manuals for my assembler, either) but the documents of primary interest to the assembly language programmer are the descriptions of the architecture and instruction set of the target machine. Sure, it's necessary to know the pseudo-ops and assembler directives; but what counts in the end is the executing code. I personally refer to the Intel documents for the instruction set and (frequently) to your book for the MS-DOS and BIOS considerations.

Probably the most compelling reason to spend the money for the latest assembler would be to take advantage of the new debugging capabilities. This is great stuff and should be given serious consideration if one intends to do more than just casual programming. However, for just gettin' the feet wet, the hundred bucks should be allowed to keep burnin' a hole in one's pocket.—Howard Carlin; Mission Viejo, California

Although I can't disagree with most of Mr. Carlin's statements, I still think Mr. Intorcio would be well advised to update his copy of MASM. Version 1.25 had some really awful bugs!

### Learning about floating-point conversion routines

I'd like to do more application programming in assembly language, but I need to use floating-point numbers. My computer has a floating-point coprocessor, and I have an assembler capable of generating the code. What I need, however, is a way to convert the floating-point numbers (IEEE format) to ASCII strings and ASCII strings to floating-point.

## ■ POWER PROGRAMMING

It would also be desirable to be able to have emulation routines for at least the four major arithmetic functions: addition, subtraction, multiplication, and division.—Gregory H. Henton (*electronic mail*)

Converting ASCII floating-point numbers into their binary IEEE-format equivalents and back again is not a trivial job. Having a numeric coprocessor available certainly helps, but it does not eliminate all of the pain! There is little to be found in print on this subject other than in rather advanced computer-science textbooks. You might want to look at Volume 2, Chapter 4, of Donald Knuth's *Art of Computer Programming* for an introduction to the problems involved, then at Figure 7-6 of the Intel 80387 *Programmer's Reference Manual* for some code examples. You can find Knuth's book at any technical bookstore and can order the Intel manual by calling (800) 548-4725.

By comparison, software floating-point routines for addition, subtraction, multiplication, and division are relatively straightforward. I'll consider this topic for future columns—though a reasonable treatment of floating-point math could drag on for months, and I feel that there are quite a few other subjects that should be addressed first!

### Options for error-handling routines make a good topic for future columns

If you are looking for topics for the Power Programming column, I would love to see a few columns on error detection, error handling, and error recovery. At work I have been given the thankless task of adding (for the first time) decent error handling wherever we do system calls. But of course nobody wants to have the code cluttered with the distraction of hundreds of `if(! . . . )` statements all over the place.

Looking through various computer books, I saw that very few really deal with errors at all. Basically, there seem to be two schools of thought: "defensive programming" (sticking in hundreds of inline error checks, scattered all over the

code) versus "error demons" (as much as possible, checking for errors in the "background"—either literally or figuratively). It would be nice to see some discussion of this in your column.—Andrew Schulman (*electronic mail*)

Philosophies and methods of error handling in MS-DOS programs can become quite an involved subject. An MS-DOS application is subject to errors of several types: faults detected by the CPU, such as

### ■ Error demons and defensive programming seem to be the two schools of thought on error handling.

divide-by-zero, which are typically lethal unless specially trapped; unexpected I/O problems (called "critical errors," such as "drive not ready"), which are detected by MS-DOS and which terminate the application unless it has installed its own interrupt 24h handler; and "recoverable" errors during an MS-DOS function call (such as specifying a file that does not exist for an "open" operation), which are always returned to the application.

We'll be taking up each of these error categories in future columns. In the meantime, some coverage of MS-DOS critical error-handling with example code can be found in Article 12 of the new *MS-DOS Encyclopedia* (Microsoft Press, 1987).

### Change Turbo C's stack size by modifying the start-up code

I've written a hard disk menu in Turbo C. The menu spawns programs and then sits in memory behind the spawned program and pops up once the program is finished running. The program works fine, but the menu, which is only 12K as a .COM file, takes up 64K in memory. I called Borland and was told that I'd have to modify the

start-up code to change the stack size. But no one at Borland, or on the Turbo C forum at CompuServe, could tell me how to modify the start-up code. I am not an assembly language programmer but, in desperation, I started playing around with the start-up code in Borland's CO.ASM file. Line 205 reads

```
; DI = Stacksize in paras
mov di, 1000h
```

I found when I moved a smaller number into DI that the program ran smaller in memory and seemed to work fine. Is this the right way to change stack size in a C program, or is there trouble lurking that, in my inexperience, I haven't noticed yet?—Dan Baumbach (*electronic mail*)

This is indeed the right spot to modify in the code. The MOV to register DI is part of the preparation for a call to MS-DOS interrupt 21h function 4Ah (Resize Memory Block). The Turbo C start-up code calls this function to shrink down the program's initial memory allocation from MS-DOS, so that other programs can run in the remaining memory.

There is a logical error in the Turbo C start-up code that doesn't show itself under normal circumstances, but could conceivably lead to problems with your modification. The author of CO.ASM moves the Turbo C program's stack pointer after he resizes the program's memory block, instead of before. Consequently, the program's stack could fall outside the memory it rightfully owns after the call to function 4Ah and, in fact, could overwrite the memory control block that MS-DOS creates for the memory which is freed up (or vice versa). If such a conflict occurs, you will most likely either see an outright crash of your program or the dreaded message "Memory allocation error, system halted" when the program terminates.

### Getting a deeper understanding of printf format strings

Your March 29, 1988, column, "Demystifying the Printf Function" tends to perpetuate a minor but common misunderstanding about the `printf` function. You correctly point out that `printf` is part of the standard library, not part of the C lan-



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## ■ POWER PROGRAMMING

guage itself, but you then forget the distinction when talking about the format string.

In the interests of rigor, it should also be noted that although the % sign is a special character to `printf`, the \ (backslash) character certainly is not. The special interpretation of \ within quoted strings is a function of the C language itself, not of the `printf` function. Ignoring this seemingly trivial distinction can lead to false statements like "To print a literal backslash character, you must double it. In other words, you must include the sequence \\ in the format string."

The truth is that to print a single backslash (or tab or new-line or whatever) you need only include the single character in the format string. The way this is done depends on the language. In the C language, backslashes are entered in string constants by coding a double backslash within the quotation marks. This is true everywhere in C where string constants are used, not just within calls to `printf`.

In common usage, of course, the format argument is usually a string constant, but it can also be built on the fly, read in from a file or device, or even (as you make clear) passed from an assembly language program. In these cases, using a double backslash would not produce the desired results. The assembler example in the same column illustrates this distinction, but it should be made quite explicit for the benefit of those who are using the column as a tutorial.—*Gary Novosielski; West Caldwell, New Jersey*

Quite right; I want to thank Mr. Novosielski for writing to emphasize this point. The special handling of "escape sequences" such as \n (new-line), \t (tab), and \\ (backslash) within quoted strings is a function of the C compiler's parser and has nothing particular to do with `printf`.

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■ DOUGLAS COBB AND STEVEN COBB

# SPREADSHEET CLINIC



*Modifying standard ranking formulas to return a range for duplicate values; Quattro's versus 1-2-3's {For} commands; copying existing records in a Symphony database.*

## Copying existing records within a FORM window in Symphony

One drawback to *Symphony's* FORM environment is that it does not feature a command or key to make a copy of an existing record. Even if the record you want to enter is almost identical to one that is already in the database, you must enter the new one from scratch—that is, unless you use the macro shown in Figure 1.

This macro allows you to make copies of existing records in a *Symphony* database from within a FORM window. Before you invoke this macro, assign the range name VALUE to the cells of the Definition range's Value column. (Be sure not to include the cell that contains the label "Value in the range.") Also, assign the name DATABASE to the Database range. (Include the row of field names in this range.)

Now use the PgUp and PgDn keys to bring the record you want to copy into view within the FORM window. At that point, a copy of the entries from that record will be in the Value column of the Definition range. Then, you should press Alt-C to invoke the macro.

The first statement in this macro freezes the screen and changes the type of the window from FORM to SHEET. The second moves the cell pointer to the blank row below the last record in the database, then uses the (Menu) Range Transpose command to copy the entries from the cells of the Definition range's Value column into the cells of that row. Since the Value column will contain the record you want to

	A	B	C	D	E	F	G
1	\c	{WindowsOff}	{PanelOff}	{Type}s			
2		{Goto}DATABASE"	{End}	{Down}	{Down}	{Menu}rtVALUE"	
3		{Menu}rncDATABASE"	{Down}				
4		{Switch}	{WindowsOn}	{PanelOn}	{End}		
5							

**Figure 1:** This macro lets you make copies of existing records within a *Symphony* FORM window.

copy at this point, *Symphony* places a copy of that record at the bottom of the database.

The third statement expands the Database range to include the new record. The final statement changes the type of the window back to FORM, unfreezes the screen, and brings the new record (the copy of the existing record) into view.—Richard Lyon; Falls Church, Virginia

This macro should be useful for anyone who does a lot of work in *Symphony's* FORM environment. Experienced macro programmers may wish to modify this macro so that it makes copies of the entries in selected fields of a record.

## A subtle difference between Quattro's and 1-2-3's execution of the {For} command

Recently, I stumbled upon an obscure but important difference between the operation of *Quattro's* {For} command and the one found in *Lotus 1-2-3*. The form of the {For} command in both programs is

(For counter cell, start value, stop value, step value, subroutine)

If you specify a positive step value, *Quattro's* {For} command works just like 1-2-3's. However, they do not work in the same way if you specify a negative step value.

Before executing the commands in the subroutine for the first time, 1-2-3 places the start value into the counter cell. Then when 1-2-3 executes a {For} command that specifies a positive step value, it continues to make passes through the subroutine (specified by the fifth argument) until the value in the counter cell exceeds the stop value. Before each subsequent execution of the subroutine, 1-2-3 increases the value in the counter cell by the step value.

For example, the command {For COUNT, 1, 5, 1, TEST} will cause 1-2-3 to execute the commands in the subroutine named TEST five times. Before making the first pass through the loop, 1-2-3 will enter the value 1 into COUNT; before making the second pass through the loop, 1-2-3 will increase that value to 2; before making the third pass, 1-2-3 will increase that value to 3; and so forth. This command works exactly the same way in *Quattro* as it does in 1-2-3.

Before 1-2-3 executes a {For} command that specifies a negative step value,

## ■ SPREADSHEET CLINIC

	A	B	C	D	E	F
1	\f	{GetNumber "Value to factorial?" , FACTORIAL}				
2		{FOR COUNT, FACTORIAL-1, 2, -1, LOOP}				
3						
4						
5	LOOP	{Let FACTORIAL, FACTORIAL*COUNT}				
6						
7	FACTORIAL					
8	COUNT					
9						

**Figure 2:** This macro will not work in Quattro, because of the use of a negative step argument in the {For} command.

it places the start value into the counter cell. Then it executes the subroutine (specified by the fifth argument of that command) until the value in the counter cells drops below the step value. Before each subsequent execution of the subroutine, 1-2-3 decreases the value in the counter cell by the step value.

For example, the command {FOR COUNT, 5, 1, -1, TEST} will cause 1-2-3 to execute the commands in the subroutine named TEST five times. Before making the first pass through the loop, 1-2-3 will enter the value 5 into COUNT; before making the second pass through the loop, 1-2-3 will reduce that value to 4; before making the third pass, 1-2-3 will reduce that value to 3; and so forth.

Unfortunately, Quattro does not deal with negative step arguments in the same way. Whether the step argument of a {For} command is positive or negative, Quattro will execute the subroutine until the value in the counter cell exceeds the positive step value. In all practical cases, this means that Quattro won't make even one pass through the {For} loops of this sort.

Consider the command {FOR COUNT, 5, 1, -1, TEST}. Before executing the subroutine named TEST for the first time, Quattro places the value 5 into COUNT. Since 5 is greater than 1 (the stop value), Quattro will cancel the execution of the {For} command before it makes any passes through the loop.—Jeff Yocum; Louisville, Kentucky

It seems that Borland has failed to include many subtle features of 1-2-3's {For} command in Quattro. As a result, 1-2-3 macros such as the one shown in Figure 2, which calculates the factorial of the value

you specify, will not work in Quattro.

While we're on the subject, there seems to be another problem with Quattro's {For} command. In most cases, Quattro cancels the execution of a {For} command as soon as the counter value becomes negative—regardless of the stop value. Given the command {FOR COUNT, 1, -5, -1, LOOP}, Quattro will make only two passes through the loop specified. 1-2-3 will make seven.

### Productivity Tip

To learn more about how worksheets are stored in 1-2-3, *Symphony*, and *Jazz*, read the book *File Formats for 1-2-3, Symphony, and Jazz*. Published by Addison-Wesley Publishing Company under the Lotus Books logo, this book contains detailed information about the structure of 1-2-3, *Symphony*, and *Jazz* files. To order, call (617) 944-3700.

### Improving upon the standard ranking technique

In the April 12, 1988, issue's Spreadsheet Clinic, Larry Roshfeld submitted an excellent ranking technique. However, as you pointed out in your comments to Mr. Roshfeld, these formulas give the same ranking to duplicate values. For example, given the four values 150, 100, 50, and 100, these formulas would assign the ranking 1 to the value 150, the ranking 2 to both occurrences of the value 100, and the ranking 4 to the value 50.

I've developed a better way to deal with ties. My method returns the string form of

the ranking for nonduplicate values, and a string in the form x-y for duplicate values, where x is the lowest possible ranking of the value, and y is the highest possible ranking of that value. The formulas for the worksheet shown in Figure 3 return the string 1 for the value 150, the string 2-3 for both occurrences of the value 100, and the string 4 for the value 50.

Cells B2..B5 of this worksheet contain the formulas

```
B2: @SUM($A$2:A2, $A$3>$A2, $A$4>$A2, $A$5>$A2)+1
B3: @SUM($A$2:A3, $A$3>$A3, $A$4>$A3, $A$5>$A3)+1
B4: @SUM($A$2:A4, $A$3>$A4, $A$4>$A4, $A$5>$A4)+1
B5: @SUM($A$2:A5, $A$3>$A5, $A$4>$A5, $A$5>$A5)+1
```

These are simple ranking formulas. As you can see, they return the values 1, 2, 4, and 2, respectively.

Cells C2..C5 contain the formulas

```
C2: @COUNT($A$2..$A$5)-
@SUM($A$2>$A2, $A$3>$A2, $A$4>$A2, $A$5>$A2)
C3: @COUNT($A$2..$A$5)-
@SUM($A$2>$A3, $A$3>$A3, $A$4>$A3, $A$5>$A3)
C4: @COUNT($A$2..$A$5)-
@SUM($A$2>$A4, $A$3>$A4, $A$4>$A4, $A$5>$A4)
C5: @COUNT($A$2..$A$5)-
@SUM($A$2>$A5, $A$3>$A5, $A$4>$A5, $A$5>$A5)
```

The first part of each of these formulas returns the number of values that 1-2-3 is ranking—in this case, 4. The second part returns the number of values that are less than the value to which the formula applies. In this case, the second part of the formula in cell C2 returns the value 3, since the values in cells A3, A4, and A5 are less than the value in cell A1. However, the second part of the formula in cell C3 returns the value 1, since only the value in cell A4 is less than the value in cell A3.

Subtracting the result of the second part of each of these formulas from the result of the first part produces the highest possible ranking for the value to which that formula corresponds. For values that have no duplicates, this result will be the same as the one returned by the corresponding formula in column B. For example, the formula in cell C2 returns the value 1 (4-3). For values that have duplicates, however, the result of each formula in column C will be equal to the result of the corresponding formula in column B, plus the number of occurrences of the value that the formulas are ranking. Since there are two occurrences of the value 100 in cells A2..A5, each of the formulas in cells C3 and C5 returns the value 3 (4-1).



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## ■ SPREADSHEET CLINIC

	A	B	C	D
1	Value	High Rank	Low Rank	Combined Rank
2	150	1	1	1
3	100	2	3	2-3
4	50	4	4	4
5	100	2	3	2-3
6				

Figure 3: The ranking formulas in this worksheet return a "range" for duplicate values.

The functions in cells D2..D4

D2: `=IF(B2<C2, @STRING(B2, 0), @STRING(B2, 0) & "-" & @STRING(C2, 0))`  
D3: `=IF(B3<C3, @STRING(B3, 0), @STRING(B3, 0) & "-" & @STRING(C3, 0))`  
D4: `=IF(B4<C4, @STRING(B4, 0), @STRING(B4, 0) & "-" & @STRING(C4, 0))`  
D5: `=IF(B5<C5, @STRING(B5, 0), @STRING(B5, 0) & "-" & @STRING(C5, 0))`

return the final ranking of the values in cells A2..A5. If the result of the formulas in columns A and B for any value are equal, 1-2-3 returns the string formula of that result. The formula in cell D2 returns the string "1", and the formula in cell D4 returns the value 4. If the results of the formulas in columns B and C for any value are different, however, the formula in column D will return a string in the form x-y, where x is the result of the formula in column B (the "low" ranking) and y is the result of the formula in column C (the "high" ranking). For example, the formulas in cells D3 and D5 both return the string "2-3"

Because of the judicious use of absolute references within these formulas and functions, you need to type them in only the first cell of each column. Then you can use the /Copy command to enter the appropriate versions for the other values that you want to rank.—*Dan Boyk; Ann Arbor, Michigan*

This technique is a useful modification of the standard ranking technique. Because the formulas in cells D2..D5 return strings, however, it will be necessary for you to use @VALUE functions if you want to mathematically manipulate their results. Specifically, you'll want to use functions in the form

`@VALUE(@LEFT(result, 1))`

where result is the address or name of one of the formulas in column D. For example, the function `@VALUE(@LEFT(D2, 1))` would return the value 1; the functions

`@VALUE(@LEFT(D3, 1))` and `@VALUE(@LEFT(D5, 1))` would return the value 2; and the function `@VALUE(@LEFT(D4, 1))` would return the value 4. As you can see, these results are the same as the ones returned by the formulas in cells B2..B5.

## Corrections

Careful readers have pointed out the following mistakes in recent issues' Spreadsheet Clinic. In the March 29, 1988, issue, we omitted a tilde from the first statement of the macro shown in Figure 1. Cell B1 of that macro should contain the statement `'/rncRANGE?' (?)`. In addition, none of the statements in the macro have any leading space characters. The figure just makes them appear as if they do.

The April 12, 1988, issue's letter entitled "Ranking Without Sorting" mistakenly used formula references to cells in column B instead of cells in column A. The correct formulas for ranking the values in cells A2..A5 are

B2: `@SUM(A3>A2, A4>A2, A5>A2)+1`  
B3: `@SUM(A2>A3, A4>A3, A5>A3)+1`  
B4: `@SUM(A2>A4, A3>A4, A5>A4)+1`  
B5: `@SUM(A2>A5, A3>A5, A4>A5)+1`

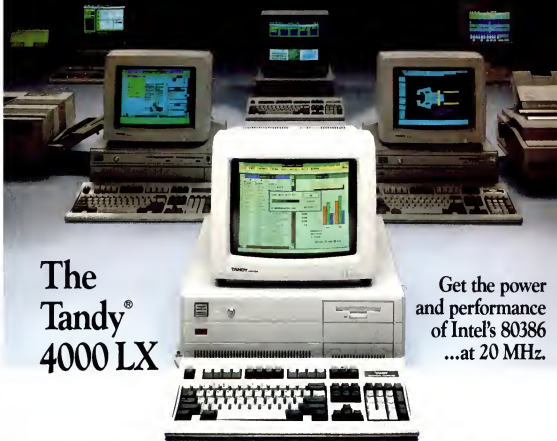
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CIRCLE 337 ON READER SERVICE CARD

■ EDITED BY SALVATORE P. RICCIARDI

# USER-TO-USER



*Save disk space by combining batch files into a single file; a dangerous anomaly using DOS 3.3's FASTOPEN command; a useful batch file for copying multiple sets of files.*

## A more versatile copy command that can work with multiple sets of files

The DOS COPY command does not allow copying more than one set of files at a time, so I created the batch file MCOPY.BAT shown in Figure 1. Its syntax is

**MCOPY FR:path TO:path [fspec fspec...]**

The FR:path represents the source drive and directory, while the TO:path represents the destination drive and directory. Multiple filespecs are allowed, as many as can fit on the command line. Each filespec can also include wildcards.—Henry Tang; Arcadia, California

I like this multiple-copy technique because it illustrates an effective use of the SHIFT command. The DOS batch file facility provides a means of accessing parameters passed on the command line through nine numbered variables—namely, %1, %2, %3 . . . %9. Each of these variables corresponds to a parameter passed on the command line, working from left to right. So, for example, if the MCOPY batch file was executed with MCOPY A B C, the batch file variable %1 would equal A, %2 would equal B, and %3 would equal C.

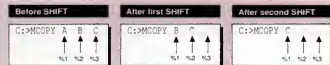
This could lead you to believe that only nine parameters can be passed on the command line. Without SHIFT, that's true. But with SHIFT, the number of parameters is limited only by the maximum length of the command line (127 bytes).

```

ECHO OFF
REM MCOPY.BAT
IF %1==. GOTO :ABORT
IF %2==. GOTO :ABORT
IF %3==. GOTO :ABORT
CD %1
SET TARGET=%2
SHIFT
SHIFT
:
: COPY
ECHO Copying %1 . . .
COPY %1 %TARGET%
SHIFT
IF %1==. GOTO FINISH
GOTO COPY
:
: ABORT
ECHO Usage: MCOPY FR:pathspec TO:pathspec [filespec filespec...]
ECHO Example: MCOPY C:\MASH A:\MASH *.ASM *.LST *.REF
GOTO :DONE
:
: FINISH
ECHO Copy process complete
:
: DONE
SET TARGET=
  
```

**Figure 1:** MCOPY.BAT illustrates an effective use of the SHIFT command while providing the ability to copy multiple sets of files.

## Using the SHIFT Command



**Figure 2:** The diagram above illustrates the effect of the SHIFT command.

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## PRODUCTIVITY

### ■ USER-TO-USER

The SHIFT command causes all the parameters to be shifted left by one. The value formerly assigned to %1 is lost. What used to be %2 becomes %1, %3 becomes %2, and so on (see Figure 2). So, if we execute MCOOPY A B C and then SHIFT, %1 will equal B. After another SHIFT, %1 will equal C. This enables the astute batch file programmer to shift every parameter through the %1 batch file variable.—Salvatore P. Ricciardi

#### A batch file technique for adding new text to a file

Developing instructions that tell new computer users how to modify AUTOEXEC.BAT is not easy. I want them to modify the PATH statement—a simple task for experienced users familiar with text editors. But novices might not have a PATH statement or even an AUTOEXEC.BAT file. And including a primer on using ED-LIN is out of the question.

To solve this problem, I came up with a unique method of allowing quick modifications to the AUTOEXEC.BAT file that requires only simple instructions on what to type at the keyboard. The INSTALL.BAT file, shown in Figure 3, will append any text typed at the console to the AUTOEXEC.BAT file and add a new directory to the PATH command.

The batch file works as follows. First, the directory is changed to the root directory where the AUTOEXEC.BAT file is located. Second, a check is made to see if the AUTOEXEC.BAT exists—if not, the ECHO statement creates it with a length of zero. Next, the ability of the COPY command to concatenate files is used to append

lines typed on the keyboard to the AUTOEXEC.BAT file. Note that COPY would normally display the two filenames AUTOEXEC.BAT and CON after this line. To avoid confusion, standard output is redirected to device NUL, which has the effect of suppressing this output.

Finally, a replaceable parameter is used to add the new directory to the existing PATH statement, or to create one if no path exists.—John W. Ross; Toronto, Ontario, Canada

There are two things I like about this small but powerful batch technique. First, it uses the considerable power of the COPY command to good advantage. Second, it gave me some great ideas for additional batch files of my own.

To make a quick-and-dirty notepad utility, I put the following commands in a batch file and called it NOTEPAD.BAT.

```
ECHO OFF
CD \
IF EXIST NOTES GOTO LABEL1
ECHO OFF > NOTES
:LABEL1
TYPE NOTES
COPY NOTES+CON > NUL
```

The TYPE command allows me to see the text that I have previously entered, and the COPY command lets me append to it.—Robert L. Hummel

#### Combine batch files into a single file and save disk space

DOS is wasteful when it allocates an entire cluster of disk space for every short batch file, so I developed a batch file library

```
ECHO OFF
ECHO Enter AUTOEXEC Commands as instructed in the manual.
ECHO Press the F6 key when done.
CD \
IF EXIST AUTOEXEC.BAT GOTO LABEL1
REM CREATE EMPTY FILE
ECHO OFF > AUTOEXEC.BAT
:LABEL1
COPY AUTOEXEC.BAT+CON > NUL
PATH=%PATH%;D:\NEWDIR
```

**Figure 3:** The INSTALL.BAT file shown above allows commands to be appended to AUTOEXEC.BAT and a new path added.

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## ■ USER-TO-USER

(shown in Figure 4). It includes seven short batch programs that individually would take up seven clusters, or at least 14K of disk space. With this library technique, only one cluster of disk space is used even if the library expands to almost twice its size.

Before you run DO.BAT, make sure the DOS CHKDSK, FIND, and MORE commands are accessible, as the example library uses these files.

The syntax for calling DO.BAT is

```
do function [param1 param2 ...]
```

Each function is a batch program module within DO.BAT. Remember when adding functions to DO.BAT that you must precede the function name with an underscore for the module label (for example, \_NEWMOD) and end each module with a GOTO END statement. Also remember that the parameters will start at %2, because %1 is the module name itself.

```
@ECHO OFF
IF %1==X GOTO NOPAR
GOTO _%1
REM ----- Lists available functions
:_LIST
  _ECHO VALID COMMANDS ARE:
  TYPE %0.BAT | FIND ":" | FIND/V "FIND/V" | MORE
  GOTO END
REM ----- Finds files anywhere on disk
:_WHERE string [d:]
  _CHKDSK %3 /V | FIND "%2"
  GOTO END
REM ----- DIR of directories only
:_DDIR [path]
  _DIR %2 | FIND "<DIR>"
  GOTO END
REM ----- DIR of files only
:_FDIR [path]
  _DIR %2 | FIND/V "<DIR>" | FIND/V " " | FIND/V "free"
  GOTO END
REM ----- Adds path to current PATH environment
:_ADDPATH path
  PATH=%PATH%;%2
  PATH
  GOTO END
```

(continues)

Figure 4: A sample batch file library that illustrates a way to save disk space by combining many small batch files into a single file.

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CIRCLE 252 ON READER SERVICE CARD

## ■ USER-TO-USER

```

REM ----- Sets or returns to home directory
:_HOME [path]
  IF %2X==X GOTO CHANGE
  SET HOMEDIR=%2
  :CHANGE
  IF NOT %HOMEDIR%X==X CD %HOMEDIR%
  GOTO END

REM ----- TYPES file one screen at a time
:_SEE filename
  TYPE %2 | MORE
  GOTO END

REM ----- Copies to new path, deletes from old
:_MOVE pathname pathname
  COPY %2 %3
  DEL %2
  GOTO END

REM ----- No function error message
:_NOPAR
  ECHO Error - No FUNCTION specified
  ECHO      For list type = %0 LIST =
  GOTO END
:_END

```

(Figure 4 ends)

The function LIST provides a listing of all programmed functions. It extracts them from DO.BAT itself. If you will be using DO.BAT on a VDISK, make sure you

leave about 8 to 10K of empty space for the temporary pipe files that the DOS filters will create.—E. Brent Ashley; Mississauga, Ontario, Canada

I like to avoid tiny batch files for exactly this reason. Cluster size can be 2K or more, depending on the disk and DOS version, and every file takes at least one cluster. This solution collects your common batch operations into one file.

Some of the functions in the example DO.BAT need explanation. First off, users of DOS versions before 3.3 will have to omit the @ character in the first line. In DOS 3.3, a batch line starting with @ executes without displaying. This lets you avoid the ever-visible ECHO OFF line.

The LIST option types the currently executing batch file (that's what %0 means) and filters the output. The first FIND command locates all lines that contain . . . The second one excludes (/V option) lines containing FIND/V. Without that second filter, the batch file would print the FIND line along with the actual list of functions.

These may not be the functions you would choose for yourself. If not, by using

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## ■ USER-TO-USER

the techniques shown here you can do your own DO.BAT.—Neil J. Rubenking

### A dangerous anomaly using the DOS 3.3 FASTOPEN command

I've found that it's possible for one subdirectory to have two names at the same time. If you rename a recently referenced subdirectory while FASTOPEN is loaded, this anomaly occurs.

Three things must have happened. First, you must have invoked FASTOPEN, which acts as a cache for directories. Second, you must have run a program from that subdirectory recently, so the directory's name and physical address are in the cache. Third, you must rename the directory with one of the many utilities available. [Only some of them will cause this problem; see below.—Ed.]

The result is one physical subdirectory

known by both its new name and its original name. DOS will behave as though it has two distinct subdirectories with two distinct names, but the files are shared by both. If you add a file to one directory, it will also appear in the other. If you delete a file from one, it will also be deleted from the other.

Of course, if you're not aware of this condition, it could lead to some dangerous situations. For example, noticing the duplication, you might delete all of the files in one of the directories.—Joe Cygan; Montreal, Quebec, Canada

DOS has an internal function for renaming files. Don't confuse this function with the RENAME command—RENAME uses only part of the internal function's power. Starting with DOS 3.0, the internal rename function works on subdirectories. Any utility (for example, PC Magazine's RENDIR) that uses this function will work

perfectly with FASTOPEN, but will not work at all with DOS 2.x.

To rename a directory under DOS 2.x, a program must bypass DOS and directly manipulate the parent directory. This behavior is what causes the trouble with FASTOPEN. Since FASTOPEN works only with DOS 3.x, the best solution is to rename directories with utilities that are specific to DOS 3.x.—Neil J. Rubenking

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■ EDITED BY CRAIG L. STARK

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*Printing subsets of a master list in Microsoft Word; compiling a bibliographic reference list with WordPerfect macros; appending new records to dBASE files.*

## A universal technique for appending records in dBASE III Plus and its work-alikes

The most efficient way to append new records to a dBASE file requires initializing memory variables that match the fieldnames in the database. The technique I use is completely generic: it works exactly the same way whatever database structure is used. Moreover, it's compatible not only with dBASE III Plus but also with its work-alikes.

Begin by issuing the two commands, GO BOTTOM and SKIP. This puts you in a dBASE never-never land, where you're pointing to a phantom record whose RECNO() is one greater than the file's RECCOUNT(), but whose "fields" act in some ways as if you had just issued the APPEND BLANK command.

Your program should then execute the DO WHILE shown below, which loops once for each field and initializes a complete set of memvars that have the same name, type, and length as the fieldnames:

```
num=1
DO WHILE TYPE(FIELD(num))$"U"
  IF TYPE(FIELD(num))$"M"
    x=FIELD(num)
    PUBLIC &x
    &x=&x
  ENDIF
  num=num+1
ENDDO
```

Inside the loop, the `x=FIELD(num)` command establishes a temporary memory variable that is a character string consist-

ing of the fieldname. Next, the PUBLIC command declares that a memory variable whose NAME is the fieldname shall be known throughout the program and not forgotten when the procedure exits.

Then comes the outlandish command: `&x=&x`. The left-hand macro initializes a new memory variable whose name is the fieldname; the right-hand macro defines its contents to be the contents of the database file with that fieldname.

The DO WHILE loop executes this procedure for as many fieldnames as your database includes. By declaring each new memory variable in this way, you automatically establish the correct field type and length of each memvar-field twin. Since the file pointer is positioned beyond the End-Of-File, the contents of these phantom fields are blank—but they can be evaluated. So if FIELD(num) is a Character type, its memory variable will be a string of spaces whose length is the field length; if FIELD(num) is a Numeric type, its memory variable will equal 0 (and will reflect decimals if present); if FIELD(num) is a Date type, its memory variable will be an empty (null) date; if FIELD(num) is a Logic type, its memory variable will be False.

As usual, memo fields present a problem. When `&x=&x` is issued and FIELD(num) is a Memo type, dBASE III Plus responds with the error "Operation with Memo field invalid." So the "IF TYPE..." line in the loop simply excludes memo fields.

One caveat: when using these memory variables in REPLACE statements, re-

member to specify the M-> alias. This will prevent dBASE from preferring the field variable over the memory variable, which would blank the new record.

Other ways to accomplish standard memvar initialization have appeared in this column in our September 13, 1988, and October 27, 1987, issues, but this is the one I prefer.—Brad Stark

## Building a reference list for bibliographic citation with WordPerfect macros

The macros presented in Figure 1 facilitate one of the more tedious tasks of scientific writing: compiling an alphabetized bibliographic reference list of works cited in a text. We have found these macros have increased our accuracy and reduced the time involved by a factor of six.

The CITES macro (Figure 1, top) combs a text for standard author/date citations contained in parentheses. The Extended Search feature found in WordPerfect, Version 4.2, extends the search into footnotes and endnotes. CITES puts a list of all the parenthetical statements found, one statement to each line and cleansed of its parentheses, into DOC 2.

The TIDY macro (Figure 1, center) separates strings of multiple citations set off by semicolons. It also removes much of the garbage CITES produces, such as citations beginning with "c.g.," or "see". It then alphabetizes the remaining lines, using WP's line-sort procedure.

After running TIDY, you must edit the





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text to remove parenthetical statements that are not citations. When a writer refers to an author in the text and puts only the publication date in parentheses, that date will appear at the top of the list. Search on the date in the original document to find the author's name and copy it to DOC 2.

When you use the same references in multiple publications, you can use a file containing references from previous papers. Create such a REF file cumulatively by block-copying from papers, or just type it independently. Prepare new entries for the REF file in standard form. When entering them, separate each reference with two hard Returns. A paragraph sort keeps REF

alphabetized after you add new references.

The payoff comes in future papers. Run CITES and TIDY and print their output. Now discard the contents of DOC 2 and load the REF file there. Switch to the paper in DOC 1 and put the cursor at the end of it. With the screen switched to the REF file, put the cursor anywhere in the first citation from the printed list. Press Alt-R to copy the complete reference to the paper. The Alt-R macro (Figure 1, bottom) copies the reference, moves down for the next entry, and pauses to let you verify before returning to the REF file. Repeat this for each item on the printed list.

When the printed list contains a new ci-

### The CITES macro

```
<Ctrl-F10>
CITES<CR>
<Home><F2><F2>
<Alt-F4>
)
<Left>
<Ctrl-F4>2
<Shift-F3>
<Ctrl-F4>5
<Home><Home><Down>
<CR>
<Shift-F3>
<Alt-F10>CITES<CR>
<Ctrl-F10>
```

Begin macro definition  
Call it CITES  
Extended search for left parenthesis  
Block on  
Extend block to next right parenthesis  
... but don't include it in the block  
Copy block  
Switch to Doc 2  
Retrieve the reference  
Go to the end of Doc 2  
Add a carriage return  
Back to Doc 1  
Call CITES again  
End macro definition

### The TIDY macro

```
<Ctrl-F10>
TIDY<CR>
<Alt-F2>
; <Space><F2>
<CR><F2>
<Home><Home><Up>
<Alt-F2>N
e.g., <Space><F2>
<F2>
(Repeat last three lines for
<Ctrl-F9>2<CR><CR>
721
<Ctrl-F10>
```

Begin macro definition  
Call it TIDY  
Search and replace w/o confirm  
Find "; "  
Replace with carriage return  
Back to the top  
Search and replace w/o confirm  
Find "e.g., "  
Replace with nothing  
other phrases, "see," "i.e.," etc.)  
Sort the screen  
Select line sort, perform action  
End macro definition

### The Alt-R (Reference) macro

```
<Ctrl-F10>
<Alt-R>
<Ctrl-F4>22
<Shift-F3>
<Ctrl-F4>5
<Home><Home><Down>
<Ctrl-FgUp>15<CR>
<Ctrl-FgUp>255<CR>
<Shift-F3>
<Ctrl-F10>
```

Begin macro definition  
Call it Alt-R for Reference  
Copy the current paragraph  
Switch back to Doc 1  
Retrieve text  
Go to end  
Pause so user can see reference  
Return to normal speed  
Back to REF list in Doc 2  
End macro definition

Figure 1: Three WordPerfect macros that facilitate creation of a scientific bibliography from the citations within a text.

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tation, enter its full form into the REF file at the proper alphabetic location. In this way, the REF file will grow cumulatively. After six months' use, ours now has 700 entries.—Barry Wellman, Cyndi Rottenberg, and N. Scott Wortley; Toronto, Ontario, Canada

Editor Bill Machrone has suggested that we should do more to serve scientists better, and this set of macros will be a boon to all scientists and scholars who write with *WordPerfect*. Creating accurate reference lists is a complicated task well suited to the combination of macros and hand editing suggested by the authors.

The macro TIDY in Figure 1 assumes that the sort key parameters haven't changed from their defaults. You may want to modify it to set the keys explicitly. Before line 721 in the macro, insert

```
3<Ctrl-End><F7>
```

Pressing <Ctrl-End> while in the key-parameter screen restores the default.—Neil J. Rubenking

### Productivity Tip

Ctrl-Home is the Goto key in *WordPerfect*. Press it twice to return to the last place you gave a major motion command. Press Goto and Alt-F4 to go to the beginning of the block. Goto followed by any character will go to the next occurrence of that character.—Neil J. Rubenking

### Using hidden text and style sheets in Microsoft Word to print subsets of a master list

Bob Brody's tip to use hidden text with outlines in *Microsoft Word* (February 16, 1988) can be generalized to provide even more flexibility in controlling the text that is hidden on-screen or sent to the printer.

The key to taking advantage of hidden text is to realize that a given paragraph can be formatted both as hidden text on one style sheet and as normal text on another. By formatting each subset of information with a different paragraph style designation, you can selectively hide or view the text by attaching different style sheets.

For example, a master list of company employees might list all employees alphabetically, with some employee information formatted as DA paragraphs (for Department A) and others as DB paragraphs (for Department B). By changing to appropriate style sheets, you could then generate a list of employees for Department A (DB paragraphs formatted as hidden), a list for Department B (DA paragraphs formatted as hidden), or a list of all employees (neither DA nor DB paragraphs formatted as hidden).

To avoid confusion, note that *Word* uses the Variant number of the paragraph rather than the key code to identify the paragraph on the style sheet. It is easier to keep track of your subsets if the key codes are the same in all style sheets.—Richard A. Goldman; Pittsburgh, Pennsylvania

You can use this technique for any arbitrary number of subsets within a master list, and you can create as many combinations of subsets as you need. Building on this example, you could create separate paragraph codes for names, addresses, and phone numbers, so that you might use AN as the Key Code for Department A names, AA for Department A addresses, AP for Department A phone numbers, and so on. You could then define style sheets that would print names and phone numbers only, names and addresses only, or complete information. And you could additionally print the entire list or print by department. Also note that in many cases it will make more sense to use a single style sheet and change the definitions on an ad hoc basis. In effect, the master list becomes a database, and the style sheet a report generator.—M. David Stone

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■ EDITED BY ROBERT L. HUMMEL

# LANGUAGES

*Passing values in a FORTRAN program; a clever line-drawing program in Turbo Pascal that uses the extended character set; generating timed interrupts quickly in BASIC.*

When the Languages column was introduced in the September 29, 1987, issue of *PC Magazine*, we promised to cover five popular languages. But while we've published quite a few tips dealing with Pascal, BASIC, and C, we've seemed to neglect FORTRAN and COBOL. The truth is that tips have been few in coming for what are seen primarily as ancient languages for mainframes.

In this issue, we'll show that FORTRAN is alive and well and living on many personal computers by publishing the first in a series of tips dealing with this powerful language. It's my sincere wish that our COBOL-using readers will follow suit and send in their best programming tips and techniques.—Robert L. Hummel

## A FORTRAN pitfall that causes the value of fixed constants to change

Recently, I ran across a rather surprising feature/bug in FORTRAN. I noticed the problem when I was using a function similar to the one in the NEWVAL.FOR program shown in Figure 1, where I was passing the constant 1.0 to the function. The problem is that the number 1.0 is placed into the variable A inside the function. This variable is changed in the function and passed back to the calling program. When the main routine regains control, it surprisingly keeps the new value of the variable and uses it for all subsequent references to the constant 1.0. Thus, the output of the program is not a column of 2s and a column of 1s as would normally be

expected, but instead consists of the results shown in Figure 2.

I'm not absolutely sure what is really going on, but it must have something to do with FORTRAN passing by reference rather than by value. The compiler must assign a temporary variable so that it can pass an address, and then it somehow al-

```

C-----
C This FORTRAN program shows
C how to change the value of
C a constant.
C-----
      DO 10 I=1,10
        A=FCN(1.0)
        WRITE(*,*)A,1.0
10  CONTINUE
      STOP
      END

      REAL FUNCTION FCN(A)
        A=A+1.0
        FCN=A
      END

```

**Figure 1:** This short FORTRAN program demonstrates a nasty trap waiting to catch unwary programmers.

```

2.000000      2.000000
4.000000      4.000000
8.000000      8.000000
16.000000     16.000000
32.000000     32.000000
64.000000     64.000000
128.000000    128.000000
256.000000    256.000000
512.000000    512.000000
1024.000000   1024.000000
Stop - Program terminated.

```

**Figure 2:** The output of the NEWVAL program showing the changing value of the numeric "constant."

ways associates that variable location with the constant 1.0.

The solution to the problem is obvious (simply assign a variable to be used in the argument list and set it to the desired constant), but I thought other programmers should be aware of this situation. By the way, it is a problem I have found in all versions of FORTRAN that I have access to, ranging from those running on PCs to minicomputers to mainframes. I am using Microsoft FORTRAN, Version 4.01, on my PC, and I have tried it on a VAX 785 and a UNIVAC 11/780.—Randy Follen; Starkville, Mississippi

When a FORTRAN program is compiled, a reference to a numeric constant is, in some ways, treated just like a reference to a named variable. In this case, the first occurrence of the constant 1.0 causes a single memory location to be allocated and the value 1.0 stored there. The address of that location is then placed in the equation. Subsequent references to the constant 1.0 are replaced with the same address—there's no reason to keep more than one copy of the constant 1.0 around. But this similarity has limits. Trying to compile the line

**1.0 = 4.0**

will produce a syntax error because the compiler can recognize that this is an illegal construction. Meanwhile, the function FCN will compile without problem the following construction

**A = A + 1.0**



## ■ LANGUAGES

since it is a perfectly valid statement.

A problem occurs only when the program is executed, but neither the main program nor the FCN function is aware of it. Passing the address of the memory location containing the constant 1.0 is perfectly valid. Assigning the local variable name A to the function parameter is also valid. But when the value referenced by A is altered, changes are actually being made to the location that the compiler assumed would always contain the constant 1.0. When control is returned to the calling procedure, all bets are off.

While it can cause some frustrating programming episodes, this property of FORTRAN has always been valuable for playing tricks on unsuspecting novice programmers.—Robert L. Hummel

### Getting better resolution from the BASIC ON TIMER command

The ON TIMER command is very useful because it allows true multitasking in a BASIC program. Rather than requiring the program to control when a subroutine will be executed with GOSUB or CALL, you may simply tell ON TIMER to branch to it at timed intervals. Unfortunately, the resolution of ON TIMER is limited to increments of 1 second, which in many cases is not fine enough.

One way around this limitation is instead to use the ON PLAY command, which can transfer control to a subroutine each time a musical note is played. If the tempo is set fast enough and the notes are very short, this can be as often as 30 or more times per second.

The MESSAGE.BAS listing shown in Figure 3 illustrates this technique and a method for producing smooth, pixel-based scrolling. Rather than use PRINT statements, the bits for each character in the message are PEEKed from the ROM character table one column at a time.—James A. Parsly; Knoxville, Tennessee

BASIC programmers have often used the SOUND statement to generate very short delay times, specifying a pitch that is too high to hear. However, Mr. Parsly's clever use of ON PLAY provides even greater control. And, of course, SOUND cannot

be used for event trapping. No music is actually played in this example because note zero is used, which in the PLAY macro command language means to pause.

If 30 times per second is too fast, the speed may be varied either by adjusting the tempo or by using notes longer than 64th notes. Notice how the PLAY command is again used inside the subroutine to prime the PLAY buffer and keep the process going. Also notice that a bug in QuickBASIC 4.0 prevents this program from working

with notes that are shorter than a 32nd note duration. In that case the PC's system clock freezes, and the time does not advance.—Ethan Winer

### A clever way to draw lines on the screen in Turbo Pascal

When I first wrote a screen builder program, I just used the function keys to display the line-drawing characters in the

```

DEFINT A-Z
SCREEN 2

' set up message and window location
MESSAGES$ = ".....The quick brown fox jumped over the lazy dog"
LEFT = 220
RIGHT = 420
TOP = 0
LETHUM = 0
COLUMN = 0

LINE (LEFT - 2, TOP - 2) - (RIGHT + 2, TOP + 9), 1, B 'draw box around window
DIM BUFF(2 + INT((RIGHT - LEFT + 7) / 8) + 4) 'space for huffer
DEF SEG = &HFB00 'segment of ROM characters

' To get a smooth crawl, we must use timed interrupts. However,
' ON TIMER has a minimum interval of 1 second, which is not fast enough.
' We are forced to use ON PLAY with a song consisting of a single rest.

PLAY "NR T132 L12 NR" 'set up "song"
ON PLAY(1) GOSUB MOVEIT 'set up timed interrupt
PLAY ON 'enable timed interrupt

' A foreground task can be executing here. In this case, the time
' of day is printed on the screen.

WHILE INKEY$ = ""
LOCATE 5, 37
PRINT TIMES$
WEND
END

' Interrupt handler for ON PLAY
'
' MOVEIT receives control at regular intervals through the ON PLAY
' statement. It takes the current image in the window and shifts it
' right one column. It then adds a new column at the left hand edge.
' This creates a message that "crawls" from left to right.

MOVEIT:
GET (LEFT, TOP) - (RIGHT - 1, TOP + 7), BUFF 'get current image
PUT (LEFT + 1, TOP, BUFF, PSET 'shift image to right

' A new column is added at the left. This is constructed using the
' character pattern table located in ROM at FB00:FA5E

COLUMN = COLUMN + 1
IF COLUMN = 9 THEN
COLUMN = 1
LETHUM = LETHUM + 1
IF LETHUM > LEN(MESSAGES$) THEN LETHUM = 1 'wrap around if necessary

'compute offset into pattern table for the new letter
OFFSET = &HFA5E + ASC(MID$(MESSAGES$, LETHUM)) - LETHUM + 1, 1) * 8
END IF

'copy one column of the pattern into the left edge of the window
FOR ROW = 0 TO 7
BIT = OFFSET + ROW
BIT = (PEEK(BIT) AND 2 * (COLUMN - 1))
IF BIT = 0 THEN PSET (LEFT, TOP + ROW) ELSE PSET (LEFT, TOP + ROW)
NEXT

PLAY "NR NR" 'create a new "song"

```

Figure 3: A BASIC example showing how ON PLAY can generate timed interrupts very quickly.

PC's extended character set. This had three undesirable side effects. First, the rest of the user interface was very awkward. I had to use Alt-letter sequences, since I needed all of the Ctrl- and function-key sequences for characters. Second, in practice, it was hard to remember how to turn corners and make intersections.

Third, it hurt my ego every time I sat down to a good word-processing program with a proper line-drawing routine.

Figure 4 illustrates one way to use the extended character set to draw lines on the screen. The program is strongly table-driven. The array "connect" contains most of the intelligence about the character set.

Each element of the table corresponds to one of the available line characters. The entry describes its appendages—top, right, bottom, left. The corresponding position in the entry encodes the style of line in each section. The styles are 0, no line; 1, single line; 2, double line. The program constructs an image of the character it

(NOTE: This is a Turbo Pascal 4.0 program, but you can convert it for TP3 easily enough. There are two places you have to change, both marked with "TP3". Look for that marker and follow the instructions.)

```

(**)
(*TP3*)(*To use with TP3, comment out the line above and
      UN-comment out the line below*)
(* (*(*,C=) *)
PROGRAM LineDraw;
(*TP3*)(*Delete the next line for use with TP3*)
USES CRT, TYPED;
CONST

```

```

  rows = 25;           (screen size vertically and horizontally)
  cols = 80;

```

```

VAR
  CH, CH2 : Char;      (character read from keyboard)
  screen : ARRAY[0..28, 0..81] OF Char; (THE IT is too big!)
  drawing : Boolean;    (true while drawing)
  Erase : Boolean;      (true while drawing and erasing)
  row, col : Integer;   (current screen location)
  style : Integer;      (line style =
                        0 = blank, 1 = single, 2 = double)
  holdstyle : Integer;  (hold style while erasing)

```

```

PROCEDURE PUT(movement : Integer);
(movement is direction of travel: 1=up, 2=right, 3=down, 4=left)

```

```

TYPE quad = ARRAY[1..4] OF Char;

```

```

(*This array is the heart of the technique. For each drawing
  character, it describes the connecting requirements starting at
  the top and moving clockwise around it. Thus, vertical single
  line is 0110.)*)

```

```

CONST connect : ARRAY[0..255] OF quad =
  ('0110', '1011', '1012', '1021', '0021', '0012',
   '1022', '1020', '0022', '1002', '1001', '1000',
   '0011', '1100', '1101', '0111', '1110', '0101',
   '1111', '1110', '1120', '1200', '0200', '1201',
   '0202', '1200', '0202', '1220', '1202', '0201',
   '0212', '0121', '2100', '1200', '0210', '0120',
   '1212', '1212', '1001', '0110', ' ' ' ' ' ');

```

```

(*default character, for impossible matches*)
line : ARRAY[0..2, 3..4] OF Char =
  (' ', ' ', 0170010401700104, 0100020004000200);
(0170 single vertical; 0104 horizontal;
 0104 double vertical; 0200 horizontal)

```

```

VAR c : Char;          (character found to display)
    hold : quad;       (pattern for character to find)

```

```

FUNCTION check(c : Char) : Integer;
(Returns the number of lines needed to match up with the
  neighboring character C. J is a number from 1 to 4
  representing the connecting direction)

```

```

BEGIN
  IF (c >= 0170) AND (c <= 0210) THEN
    check := connect[c][J];
  ELSE check := '0';
END;

```

```

BEGIN
  (*check all four neighbors*)
  hold[1] := check(screen[row-1, col], 1); (A)
  hold[2] := check(screen[row, col+1], 2);
  hold[3] := check(screen[row, col-1], 3);
  hold[4] := check(screen[row, col-1], 2);
  hold[movement] := Ch(style*ord('0')+1);
  (*required pattern is built - does any character match it?*)
  connect[0210] := hold; (B)
  c := 0210;
  WHILE connect[c] <> hold DO c := succ(c);
  (*if no match, use default plain line instead*)
  IF c = 0210 THEN c := line[style, movement];

```

```

screen[row, col] := c;
Write(c, ' ');
END;

```

```

BEGIN (draw)

```

```

  ClrScr;

```

```

  WriteLn('Line Drawing Made Easy');

```

```

  WriteLn('Touch ');

```

```

  WriteLn('UP');

```

```

  WriteLn('LEFT');

```

```

  WriteLn('RIGHT');

```

```

  WriteLn('DOWN');

```

```

  WriteLn(' ? = START / STOP ERASING ');

```

```

  WriteLn(' 0 = SWITCH LINE STYLE TO OPPOSITE TYPE ');

```

```

  WriteLn(' 1 = START / STOP DRAWING ');

```

```

  WriteLn('ESC = EXIT ');

```

```

  WriteLn('WriteLn('Touch <enter> to begin');

```

```

  ClrScr;

```

```

  FillChar(screen, SizeOf(screen), ' ');

```

```

  row := 12;

```

```

  col := 40;

```

```

  style := 1;

```

```

  REPEAT

```

```

    GoToXY(col, row);

```

```

    ReadKey; CH;

```

```

    IF (CH = 027) AND KeyPressed THEN ReadKey; CH2;

```

```

    ELSE CH2 := 00;

```

```

    CE := UpCase(CH);

```

```

    IF drawing THEN

```

```

      CASE CH OF

```

```

        027 : CASE CH2 OF

```

```

          '0' : IF row > 1 THEN BEGIN put(1); row := row-1; END;

```

```

          '1' : IF row < row THEN BEGIN put(3); row := row+1; END;

```

```

          '2' : IF col < col THEN BEGIN put(2); col := col+1; END;

```

```

          '3' : IF col > 1 THEN BEGIN put(4); col := col-1; END;

```

```

        END; (case CH2)

```

```

        '0' : BEGIN

```

```

          IF Erase THEN

```

```

            BEGIN

```

```

              style := holdstyle;

```

```

              Erase := False;

```

```

            END;

```

```

            drawing := False;

```

```

          END;

```

```

          '0' : IF NOT Erase THEN style := style MOD 2+1;

```

```

          ELSE Write(027);

```

```

        '1' : IF style <= 0 THEN

```

```

          BEGIN

```

```

            holdstyle := style;

```

```

            style := 0;

```

```

            Erase := True;

```

```

          END;

```

```

        ELSE

```

```

          BEGIN

```

Figure 4: LINEDRAW.PAS illustrates a method for using the extended character set to draw lines on the screen.

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## ■ LANGUAGES

needs by checking all four neighbors at the new location and the direction of movement. It then searches in the array "connect" for this pattern. If it finds the pattern, it uses the corresponding character. If not, it uses a default character.

Notice that at {A} the four calls to function "check" build a possible character description for the next character to draw. At {B} the program searches the table for a match. It puts the item being sought as the last entry to guarantee that the search will end. If it reaches that last item without another match, the required character doesn't exist, and it substitutes a default character.

The character depends on the line style, the neighboring characters, and the direction of movement. The program cannot write it until the cursor moves out of the screen location. This is not so strange, since a pencil doesn't write until it moves off the spot it is sitting on. If a line is about to meet another and you wish to cross it, move ahead and you will get the correct crossing character. If you wish to end it on the other line, you must move in the direction of the other line. You will then get a T. To make a corner with a line, move up to the end of the line and move in its direction. You will get the desired corner. If you continue moving straight ahead, you will get a T-connection. —Albert C. Christoph, Ferndale, Michigan

At first glance, it might appear that this program is writing directly to video RAM. It's fast enough to suggest that. But actually it's putting characters to the display with a simple Write statement and keeping a separate map of the display in the array "screen". I drew quite a tangled mess on the screen, and LINEDRAW handled it all. —Neil J. Rubenking

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# PC TUTOR



*Every time you use the CLS command, DOS sifts through a bewildering array of information. Here's a peek behind the scenes of how COMMAND.COM clears the screen.*

## How the DOS CLS command handles various displays

The DOS command CLS (CLear Screen) may appear to perform a simple task: clearing the screen. But the portion of COMMAND.COM responsible for implementing CLS must function within many very different environments: text modes, graphics modes, redirected output, and user-installable device drivers. Each situation must be handled differently, sometimes producing unexpected results.

The logic of the CLS command hasn't been documented, but it may be divined by disassembling COMMAND.COM and examining the assembly code instructions directly. I'll leave the explanation of how the disassembly of COMMAND.COM is done for another column and concentrate on describing the CLS process. But first, here's some background information we'll need to understand the final puzzle.

**FILE HANDLES** DOS provides many methods for transferring data to and from disk files and devices. In one method, we pass the filename to DOS and receive, in return, a 16-bit number that uniquely identifies that specific file or device. This number, which may then be used as a shorthand version of the file or device name, is termed a *file handle*.

So, for example, we might pass DOS the filename C:\TUTOR.TXT and receive as the file handle the number 6. Then, to read the file, we would simply say "read from handle 6." DOS would remember

the filename for us. The BASIC statement OPEN "TUTOR.TXT" AS #6 uses the same type of correspondence between a filename and a number. File handles can refer either to a disk file or to a device, such as a printer (LPT1:).

A complete discussion of the mechanics of using file handles isn't needed to understand CLS. What is important to know is that five file handles are designated by DOS to have standard, default assignments. The handles are numbered 0 through 4, and their usage and default assignments are given in the table shown as Figure 1. The file handle we'll keep our eye on is 1, STDOUT. The file or device pointed to by this handle indicates where DOS screen output is sent: this is normally the active video display.

**CLS INTERNALS** Let's assume we've gotten past the point where COMMAND.COM decides that CLS is an internal command and branches to the subroutine responsible for clearing the screen. Figure 2 contains a source code listing, complete with comments, of the portion of COMMAND.COM that implements the CLS command.

First, a call is made to the DOS function 44h. This complex function, called I/O Control for Devices (IOCTL), lets programs determine information about a device driver rather than just exchange characters. The proper subfunctions of IOCTL can determine if a drive is removable, format logical tracks, and determine if a file handle points to a disk file or a device. This last property is used by CLS.

IOCTL is called with AX=4400h and BX=1 to request the status of the device assigned to file handle 1. The function returns the device information as 16 one-bit flags in the DX register. The meaning of each bit is shown in Figure 3. To test if a particular bit is set, the TEST instruction is used. This instruction sets the 8088 flags as if an AND had been performed but doesn't change the data. In the code listing, the result of TESTING the DL register with 80h will be 0 unless bit 7 is 1.

Bit 7 (ISDEV) is 0 if the file handle refers to a disk file, and 1 otherwise. If STDOUT refers to a file, the result of the test will be 0. Consequently, the code will branch to L1310 and execute the routine that sends the ANSI sequence to clear the screen to STDOUT. You can prove this to yourself by executing the command

CLS > ANSICLS

## Standard File Handles

File handle	Usage (default assignment)
0	Standard input (CON—keyboard)
1	Standard output (CON—screen)
2	Standard error (CON—screen)
3	Standard auxiliary (AUX: or COM1:)
4	Standard printer (PRN: or LPT1:)

Figure 1: The five standard devices and their default file handles.



## ■ PC TUTOR

```

CLS SUB 12B7:
    MOV     BX,1           ;File handle (STDOUT)
    MOV     AX,4400H       ;Get device data
    INT     21
    TEST    DL,66          ;If not a device
    JB      L1310          ;use ANSI sequence
    TEST    DL,10          ;(marked reserved)
    JE      L1310          ;(uses ANSI as well)
    MOV     AX,3529        ;Get vector for INT 29h
    INT     21             ;the fast COM interrupt
    MOV     DX,EB          ;Have segment in DX
    MOV     AX,3528        ;Get vector for INT 20h
    INT     21             ;the terminates vector
    MOV     AX,EB          ;Move segment to AX
    CMP     DX,AX          ;Compare them
    JA      L1310          ;Jump if int 29h higher
                                ; than 20h meaning a new
                                ; COM driver has been loaded
    MOV     AX,0F          ;Get video mode in
    INT     10             ;Thru BIOS
    CMP     AL,3           ;If text modes 0-3
    JBE     L12EC          ; jump
    CMP     AL,7           ;0: text mode 7
    JE      L12EC          ; jump
    MOV     AH,0           ;Set to same video mode
    INT     10             ; to clear graphics screen
    RET     NEAR

L12EC: MOV     AX,0BH      ;Get color palette
    XOR     BX,BX
    INT     10             ; Thru BIOS

    MOV     AX,0F          ;Get video mode in
    INT     10             ; gives column in AX
    MOV     DL,AH          ; Move to DL
    DEC     DL             ; Convert to zero based
    MOV     DH,19          ; Note that this is an
                                ; error in DOS 3.1. Should
                                ; be 0-24 (10h).
    XOR     AX,AX          ;AL=0. Entire window
    MOV     CX,AX          ;Clear row from zero to 25
    MOV     BX,700         ; Clear to grey on black
    MOV     AH,6           ; Scroll window function
    INT     10             ; Thru BIOS
    XOR     DX,DX          ; Row 0 Col 0
    MOV     BH,0           ; Page 0
    MOV     AH,2           ; Position cursor
    INT     10             ; Thru BIOS
    RET     NEAR

L1310: MOV     SI,OFFSET L3987 ; ANSI CLS string
    LODSB
    MOV     CL,AL          ; Get length
    XOR     CH,CH          ; Put count in CX
    MOV     AH,6           ; DOS direct I/O fn
    MOV     DL,AL          ; Get char
    INT     21             ; and display it
    LOOP    L131A          ; Loop until done

L131A: MOV     DL,AL
    INT     21
    LOOP    L131A

L3987 DB      4,10h,'[2J' ; The ANSI CLS string

```

Figure 2: A disassembled source listing for the portion of COMMAND.COM invoked by the CLS command.

The file will contain the four characters Esc[2J, where Esc represents the ASCII character with a value of 27 (1Bh). If ANSI.SYS isn't loaded, you can examine the file with the command

## TYPE ANSICLS

The Esc character will be displayed as a small left-pointing arrow. If you have the ANSI driver loaded, however, it will intercept the characters (before they get to the screen) and simply clear the screen.

Bit 4 of the device status word is similarly tested. This bit is consistently marked

RESERVED in all IBM and Microsoft documentation. The real name for this bit is SPECL (special); it indicates that the device driver contains an interrupt 29h handler. (But don't bother to look it up: Microsoft forgot to document this, too.)

Interrupt 29h, the *Fast I/O* or *most-favored driver* interrupt, is used to communicate directly with the screen device driver for rapid output. If the SPECL bit is set in the device status word, the ANSI sequence is sent to clear the screen.

As a final test for a substitute screen driver, COMMAND compares the seg-

ments of the vectors for interrupt 20h (terminate program) and interrupt 29h (the undocumented screen I/O handler). The vector for interrupt 20h is used to hold the address where control is returned when a program terminates; this is usually located inside the resident portion of COMMAND. If the segment for interrupt 29h indicates that a new handler has been higher in memory, the ANSI sequence is sent.

**STANDARD VIDEO** If all these tests fail, COMMAND assumes that a standard video adapter is being used. The video

## Device Driver Status Word Encoding

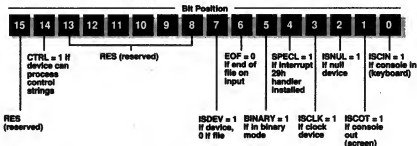


Figure 3: The decoding of each bit in the device driver status word returned by the IOCTL Get Device Information Call.



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### ■ PC TUTOR

mode is retrieved with a BIOS function. If the active video adapter is not in one of the color text modes (0 through 3) or the monochrome text mode (7), then it is assumed to be in a graphics mode. Clearing the screen is accomplished by resetting the video mode to the same value that reinitializes video memory.

If you've wondered why any colors you set in DOS disappear when you type CLS, the code at label L12EC should provide an explanation. To clear a text mode, first the border is reset to black. Then, to calculate the size of the area to clear, the number of columns on the screen is retrieved with a BIOS function. But the number of rows is hard-coded as a constant. This is terrible programming practice and is the reason CLS doesn't work in the 43-line mode of the EGA. In addition, in DOS 3.1, the number is wrong! The BIOS numbers rows starting with 0. So the maximum row number on a screen with 25 rows is 24 (18h). A mistake in the code causes an extra line to be erased. This will cause problems if you're working with more than one video page.

When the screen size is established, the color is set to Microsoft's standard gray on black, and the screen is cleared. Finally, the cursor is positioned in the upper-left-hand corner, and CLS is finished.

The CLS command is a wonderful example of how a seemingly simple task—clearing the screen—can become quite complicated to implement. Far from being ungracious, this example shows how handling varying environments is simply a matter of getting the correct information to operate with. Fortunately, DOS handles the details, and the code is never too complicated to understand.

### Ask the PC Tutor

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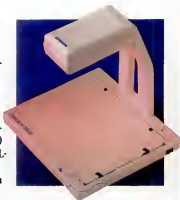
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# CONNECTIVITY CLINIC



*Matching the screen and printer drivers to the workstation configuration using the DOS environment variable; networking a small office; discovering the spark gap on 3Com cards.*

## Spark gaps on 3Com LAN cards protect chips from stray high voltage

If you are so smart about LANs, tell me why the little capacitors on the connectors on all of my 3Com 3C501 cards have little slits in them. I almost sent a card back as defective until I saw that they all looked this way.—*Vernon Williams; Manhattan Beach, California*

You found the 3Com high-voltage spark gap! This little slice of air is designed specifically to let stray high voltage jump to the ground instead of burning up the components. The spark gap protects parts such as the RF bypass capacitors and signal transformers by limiting the maximum voltage that can appear across them to something less than their own breakdown voltage. Hopefully, any stray high voltage imposed on the cable by contact with power lines, static, lightning, or other problems will jump the spark gap instead of burning holes in the chips.

## Networking a small office with a small LAN for a small cost

We have a small office with four IBM PC ATs. We use a Giltronics auto-sensing peripheral-sharing device to share two plotters, and we are happy with the arrangement. The software firm that supplies our engineering package has a new version that makes it beneficial to give everyone

access to our two databases: inventory and accounting data.

However, both my local contact for computer products and the software firm tell me that we must spend between \$10,000 and \$15,000 for a network software setup, an AT clone for a server, wiring, and training. Are there any other options available to us that allow all four computers to share the two data files? We don't need a network system to share peripherals; we don't have a computer to dedicate to the server role; and we don't want to hurt the number-crunching abilities of our existing computers.

What do we do?—*Jeff Burger; Champlin, Minnesota*

Although giving simultaneous access to the same data files isn't easy, it needn't be that expensive, either. Some of the LAN packages available today are easy to install and don't require formal training. Since you use your ATs heavily, you might want to buy a clone to use primarily as a server, keeping it available for use as a word processor and a spare workstation as well.

Two networks now compete for the status of "favorite low-cost LAN" around here. Both keep the impact on your RAM to a minimum. The first is LANtastic (see "A Field Guide to LAN Operating Systems" in the June 14, 1988, issue) from Artisoft. The second is Simple-Net from Simple-Net Systems. You should plan to spend \$200 to \$300 per node.

If you are comfortable with DOS and know how to create a batch file, you can easily install and maintain either system.

For more information contact: Artisoft Inc., 3550 N. 1st Ave., #330, Tucson, AZ 85719; (602) 293-6363. Simple-Net Systems, 545 W. Lambert Rd., Suite A, Brea, CA 92621; (714) 526-5151.

## A clever way to call the right application program drivers using a DOS environment variable

Your readers have presented a couple of different ways to match the screen and printer drivers to the workstation configuration. One method called a BASIC program and another method used NetWare's P\_STATION variable to map different subdirectories for different stations. A simpler method is to use the DOS environment space.

First, you must set a DOS environment variable (SCR, in this example) through the station's AUTOEXEC.BAT file or the NetWare log-in script commands.

In a DOS batch file, you might include the command

```
SET SCR=COLOR
```

In NetWare, you can use the IF P\_STATION command to set the environment variable to the appropriate value:

```
IF P_STATION=1000$A000000 SET SCR=COLOR
```

You should substitute the correct number of your network card and driver for the variables in this example.

Then you call the program through a batch file or the NetWare menus, using the



## ■ CONNECTIVITY CLINIC

same entry for every station:

### LOTUS %SCR%

This trick limits the amount of customization you have to do.—*Bruce Hough; Markham, Ontario, Canada*

This hint makes good use of the DOS environment feature. The percent signs around SCR tell DOS to substitute the value of the environmental factor SCR, pass it to the program, and work only inside batch files.

### Productivity Tip

RS-232C connectors are classified as Data Terminal Equipment (DTE) or Data Communications Equipment (DCE). The types of connectors determine how the cable between them is wired. The wires on pins two and three must be reversed in the cable

if the connection is between two connectors of the same type. This often is called a null modem cable. If the connectors at each end are of a different type, then the data lines go from pin 2 to pin 2 and from pin 3 to pin 3.

### DOS restrictions of the length of a filename limit the usefulness of LOG.BAT

"Creating a User Log" in the May 17, 1988, issue's Connectivity Clinic showed how to capture user statistics. But the sample string is too long. The total number of characters passed to DOS (after the % signs in the batch file are evaluated and counting everything between the double quotes) is 14. In the example shown here, the LOGIN\_NAME can be only seven characters long.—*Doug Fricke; Tampa, Florida*

The referenced contribution gave several examples of the kinds of data you can get from *NerWare*. However, it can't work if you overload the string with too many characters!

### Network Your Questions

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, *plus an extra \$25 if you submit your letter on a disk*, and we'll gladly answer any questions you have, at no charge. We're sorry, but we're unable to answer letters personally.

Mail your contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named **CONNECTIVITY CLINIC**).

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## FTC rules say:

1. The Seller must ship your order within 30 days of receiving it, unless the advertisement clearly states it'll take longer.
2. If it appears that your order will not be shipped when promised, the Seller must notify you in writing in advance of the promised date, giving a definite new date, if known, and offering you the opportunity to cancel the order with a refund or consent to a definite delayed shipping date or an indefinite delay.
3. The Seller's notice must contain a stamped self-addressed card or envelope with which you can indicate your preference. If you don't respond to this notice, the Seller may assume you agree to the delay, but must either ship or cancel your order within 30 days after the original

shipping date promised or required. A prompt refund must be made when an order is cancelled.

4. Even if you've consented to an indefinite delay, you retain the right to cancel the order at any time before the item has been shipped.
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6. In the event that the item you ordered is unavailable, the Seller may not send you substitute merchandise without your express consent.

## TIPS WHEN ORDERING

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Indicate whether you will accept a substitute product if the item you ordered is unavailable, and, if not, that your payment should be returned;

Don't send cash, you will have no record of payment if a problem arises, and;

Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your cancelled check or a copy of the money order; record of the date you mailed the order; and any sales slips and shipping receipts.

### When ordering by phone:

Note the time and date of your conversation and the name of the person you talk with;

Make a record of your order, the price, its promised availability and the components to be expected;

Save all correspondence associated with your order, including your cancelled check or a copy of the money order, and any written confirmation sent by the Seller.

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What is the Seller's refund policy?

With whom should you correspond if there is a problem?

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2. If you complain by telephone, send a follow-up letter to confirm what was said.

3. If you think the merchandise is defective, reread your product instructions and your warranty carefully to be sure you don't expect features or performance the product isn't designed to give. Then contact the Seller for instructions. Don't return it to the Seller until you have been instructed to do so.

4. When returning merchandise make sure you keep the shipper's receipt or packing slip; your right to be reimbursed for postal cost is determined by store policy.

5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

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\*Starch Study, July 1986



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T1000 w/Carry Case 799	P2400 Color, w/Tractor 24 pin 969	SONY 1311 to IBM Cable 449	THE COMPLETE PC Fax Board 349
T1100 w/Class & 789K Card 1079	P2000 w/ALQ 180 parallel 329	SONY Multisync 1303 529	
T1200F, 2 floppy w/C Case 1329	With any laptop 299	SONY 1303/2 to IBM Cable 30	
T1200FB, Backlit w/C Case 1549	NEC P2200 329	SONY 1303/2 to MAC II Cable 30	
T1200H, 1 floppy + 304MB w/C 2199	2380 w/HD, Toshiba, Zenith 515/589	TAXAN 770 MultiVision plus 519	
T1200H, Backlit w/C Case 2699	Color Kit 5200/5300 109	ZENITH Z-Scan 1490 Flat Screen 599	
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T3200 w/Carry Case 3699	★ TOSHIBA 321SL 459	Zenith Tilt & Swivel 30	
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Carry Case: Specify model			
Designer Carry Case w/pockets for SW, manuals, portable printer etc. Fits all (except T3200) 149/130			
Expansion Chassis w/Interface for 1100+/1200 or 3100/5100 689/829			
WonUnder Expansion slot for 1100+ 1100 or 3100/5100 269/279			
Toshiba 5.25" Ext 360K 339/330			
Memory 768K: T1000 299/290			
Memory 384K: T1100+ 359/340			
Memory 1MB: T1200 409/390			
Memory 2MB: T3100 869/840			
Memory 3MB: T3200 1239/1200			
Memory 2MB: T5100 1049/1020			
Modem T1000 Int: T1000 319/330			
Modem 1200 No Slot: T1200 299			
When installed 350			
Modem: T1100+ /1200/3120/5100 299/220			
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Toshiba cable for Ext Modems 20			
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<b>TOSHIBA LAPTOPS</b>	P2000 w/Tractor 679	SONY 1311CP-13" Trinitron Color 579	QUADRAM JT Fax Board 299
T1000 w/out Carry Case 759	P2100 w/Tractor 1079	Remote Tilt & RGB Monitor 449	JT Fax Portable 399
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3 Sidewriter	#523	"Print banners or long spreadsheets sideways."
4 EZ-Font Package	#404	"Business forms ready to be used or changed to fit your needs"
5 PC-File+	#5, #7, 30, #1015	"Jim Burton's popular data base"
6 HOCIBM	#870	"Let's your Hercules card run many color (CGA) programs"
7 Greatest Arcade Games	#457	"Donkey Kong, Flightmare, Spacewar and more! Color required."
8 Qube-Calc	#696	"3-D Packman, Castle, Spaceval, etc. Some require color"
9 Patrick's Best Games	#478	"Thought processor for organizing your ideas"
10 PC-Outline	#480	"Practise French, German, Spanish, Italian and a little Hebrew"
11 Languages	#612	"Desktop manager with calculator, clock, etc."
12 PC-De-Stream	#405	"Massive adventure game. Requires hard disk"
13 Netback	#1000	"Print neat letter quality on your dot matrix"
14 LQ Printer Utilities	#718	"Keep track of what you own"
15 Home Inventory	#395	"What's up, DOS? Computerize for beginners"
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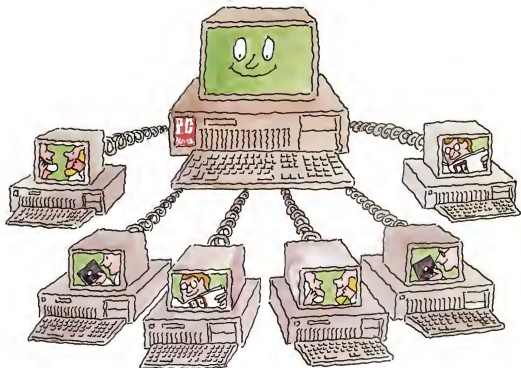
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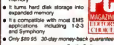
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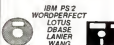
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n. ☐ 101 or more

5. Are there any PCs in your office? (Check all that apply.)

- o. ☐ Limited to mainframe  
p. ☐ Limited to mini  
q. ☐ Networked together

6. Does your company own a...  
r. ☐ Mainframe(s)  
s. ☐ Mini(s)

7. Do you plan to buy any PC products?

- t. ☐ Now  
u. ☐ In 4 to 6 months  
v. ☐ In 6 to 12 months  
w. ☐ No definite plans

8. Number of employees in your entire company?

- x. ☐ 25 or less  
y. ☐ 26-29  
z. ☐ 100-499  
1. ☐ 500-999  
2. ☐ 1000 or more

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PC 10111-4

Name \_\_\_\_\_

Business Phone (\_\_\_\_\_) \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_ Apt. \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

(Zip code must be included to insure delivery)

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1. In which of the following sectors does your organization operate? (Check one.)

- a. ☐ Private Industry  
b. ☐ Government  
c. ☐ Education

2. Your primary job function is (check one):

- d. ☐ MIS/RD Communications Systems, Programming  
e. ☐ Engineering/R&D  
f. ☐ Financial/Accounting  
g. ☐ Marketing/Sales  
h. ☐ Administrative/General Management

3. Is your company a reseller?  
i. ☐ Yes  
j. ☐ No

4. For how many IBM PCs and compatibles do you specify brands of products?  
k. ☐ 10 or less  
l. ☐ 11-25  
m. ☐ 26-100  
n. ☐ 101 or more

5. Are there any PCs in your office? (Check all that apply.)

- o. ☐ Limited to mainframe  
p. ☐ Limited to mini  
q. ☐ Networked together

6. Does your company own a...  
r. ☐ Mainframe(s)  
s. ☐ Mini(s)

7. Do you plan to buy any PC products?

- t. ☐ Now  
u. ☐ In 4 to 6 months  
v. ☐ In 6 to 12 months  
w. ☐ No definite plans

8. Number of employees in your entire company?

- x. ☐ 25 or less  
y. ☐ 26-29  
z. ☐ 100-499  
1. ☐ 500-999  
2. ☐ 1000 or more

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PC 10111-3

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Company \_\_\_\_\_

Address \_\_\_\_\_ Apt. \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

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## COMING UP

### FIFTH ANNUAL PRINTER ISSUE

It's back and better than ever! Once again, *PC Magazine's* incomparable printer blockbuster presents comprehensive evaluations of almost 90 new printers. PC Labs and 15 veteran reviewers rigorously test the latest dot matrix and laser machines to evaluate the new technology that 1988 has brought to the world of printers.

**LASER PRINTERS** Better performance, sleeker design, competitive prices, and PostScript compatibility are the hot trends for this year's crop of lasers. PC Labs evaluates 28 laser printers that belong to this new breed and puts the machines through the usual battery of speed and output-quality tests, and our team of reviewers tells you where to find the most bang for your buck. New this year: a special graphics speed test for PostScript printers that challenges their processing abilities. If you're looking to laser technology for high-quality graphics output, and you're looking to PostScript to do it, you'll find the results invaluable.

**DOT MATRIX PRINTERS** Sophistication and variety fill the dot matrix market this year, and one trend you're sure to notice is progress toward a new ease of font control. Two years ago it would have been impossible to imagine credit-card-sized font cartridges controlling typefaces in a dot matrix printer. Now it's reality. There are dot matrix printer prices to fit just about any budget and sizes to fit any desk. Machines span the spectrum from tiny-footprint models for the smallest of tasks to monster wide-carriage printers that can handle any heavy data-processing job thrown in their direction.

**OLD FAVORITES** In this issue you'll also find an extensive historical printer index that includes listings of all the printers ever reviewed in *PC Magazine's* printer issues and current information on each one. To facilitate your purchasing decisions, over 20 pages of the famous *PC Magazine* printer guide will tell you all you need to know about the printers in one set of easy-to-follow tables.

# Haven't You Heard the News?



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# AFTER HOURS



## LANGUAGES

### How to Survive a Week in Spain

BY JENNIFER ZAINO

Planning to eat nothing but cake and drink naught but champagne on your vacation tour of the fabled castles in Spain? If you are, it might help to have at least a working knowledge of the language so that you don't spend your days slurping gazpacho, downing sangria, and seeing nothing more exciting than the inside of your hotel room.

*Spanish for the Traveler*, \$59.95 from Roger Wagner Publishing, could make traveling in a Spanish-speaking country a little easier by acquainting you with some common Spanish words, sentences, and expressions. The program is divided into six units that particularly address the concerns of travelers: arrival in the country, shopping for souvenirs, sight-seeing, touring the country, getting acquainted, and dining out. A seventh section is devoted to teaching you numbers in Spanish.

You can run the program in conjunction with four audiocassettes that teach you the correct pronunciation of the words you see on your screen.

The first six units are each divided into lessons that help you get familiar with the Spanish words for the places, people, and things you can expect to encounter in each situation. For instance, the section dealing with your arrival in the country provides you with a list of words, common sentences, and stock expressions you'll need to get from the airport, to the money exchange, to your hotel.

While much of the vocabulary the program teaches brought back memories of my high school Spanish classes, some of the translations were

unfamiliar to me. For instance, *un traje de noche* (literally, a night suit) was translated as "a coat and a tie."

Short vocabulary quizzes at the end of each lesson test your command of the material you have just learned. At the end of each section, you can take a comprehensive unit test that covers all of the lessons completed thus far. Correct answers are rewarded with on-screen praise (*Maravilloso!* and *Bravo!*) and with a few computer-generated notes from such tunes as "La Cucaracha" and "Cielito Lindo."

*SFTT* does not concentrate on acquainting you with the complexities of grammatical structure. A few notes on modifying adjectives to match masculine and feminine nouns and supplying these nouns with the appropriate article is about all the specific instruction you get.

The program is unusual in that it requires that you have BASIC installed on your computer. More annoying than unique is the fact that the program cannot be copied onto a hard disk; it will operate only from a floppy disk with a write-protect tab on it.

*SFTT* is sadly somewhat behind the times. For instance, you are asked to select between running the program with an IBM Monochrome Display or a TV monitor! And the unadorned text-only screens look particularly bare against the black-and-white background.

The program won't have you speaking Spanish like a native overnight, but it will provide the bare language necessities you need to survive a stay in a Spanish-speaking country.

**List Price:** *Spanish for the Traveler*, \$59.95. **Requires:** 128K RAM, one disk drive, BASIC, DOS 1.0 or later. Not copy protected. Roger Wagner Publishing Inc., 1050 Pioneer Way, Suite P, El Cajon, CA 92020; (619) 442-0522.

CIRCLE 662 ON READER SERVICE CARD



The object of the game included with Typist is to add three layers to the block wall. Typing the letter or word correctly before it hits the bottom adds a layer.



## PERSONAL GROWTH

### Typing Tutorials: Ticking Those Keyboard Ivories

BY DONALD B. TRIVETTE

If you are one of the unfortunate souls who hunted and pecked your way through countless college term papers, there's hope for you yet. The four programs reviewed here can teach you to type and improve your speed.

#### Typist

*Typist*, a \$59.95 package from Choice Software, is a tutor and skill builder all in one. This program promises to dramatically improve your typing in only 8 hours of work.

You can choose to start with the basics by selecting the unit on learning to type or the practice sessions. Once you're feeling a little more confident of your abilities, you may want to test your skill by playing a typing game and then display your progress chart.

The Practice selection yields several submenus, one of which allows you to select specific types of material (labeled A through K) to practice on. Unfortunately, the program screen

doesn't explain what types of material those letters represent. You must turn to the manual to learn that J is the drill to practice numbers, and I is the selection with lots of capital letters.

The Test submenu lets you test your typing skills and evaluate your improvement with 13 additional drills. The Display Progress selection lets you examine how you are doing and where you need to focus your exercises. That is, if you can understand the charts, which are somewhat cryptic.

The Game selection is a good way to practice typing and to have fun at the same time. The object is simple: individual letters and words are dropped from the top of the screen, and you must type them correctly before they reach the bottom.

**List Price:** *Typist*, \$59.95. **Requires:** 256K RAM, one disk drive (both 3½- and 5¼-inch disks included), DOS 2.0 or later. Not copy protected. Choice Software, 573 E. 550 South Centerville, UT 84014; (801) 292-7900.

CIRCLE 665 ON READER SERVICE CARD

### Typing Made Easy and Typing Skill Builder

QED Information Sciences also offers help for the fumble-fingered with its two typing tutorials: *Typing Made Easy* teaches typing basics while *Typing Skill*

*"The Dell System 220 runs most PC Labs system benchmark tests at speeds that would make you think you're running a 386."*

—JOHN DICKINSON, PC MAGAZINE

*"...the System 220 has more going for it than just speed."*

—PC WORLD

*"...includes a year's on-site support...in the price of the computer. This is the sweetest support deal offered by any computer vendor in the industry."*

—ERIC KNORR, PC WORLD

*"The hot item from a technical point of view is the System 220. This machine runs a 286 processor at 20 MHz, which is its major claim to fame."*

—WILL FASTIE, PC WEEK

*"...the Dell machine is renewed evidence that the price of 286-based desktop equipment continues to drop rapidly, making such machines very attractive for daily work under MS-DOS even as they hold out the promise of running OS/2 in the future."*

—WILL FASTIE, PC WEEK

The reviews are beginning to pour in. And they read like a wish list for every power user looking to exceed the ordinary limitations of a 286 personal computer.

The computer everyone is praising in such glowing terms is the Dell System 220.

The first 286 personal computer with a clock speed of 20 MHz.

It's totally compatible with MS-DOS and MS OS/2 and is faster than many 386 computers. Yet it sells for much less.

Because you buy it direct from us. Eliminating the mark-ups and margins of computer stores.

We design and build every Dell computer right here in Austin, Texas.

We put each and every one through a comprehensive burn-in and a battery of diagnostic tests before we ship it.

And after we ship, we give you the best technical support you'll find anywhere in the computer industry.

Our technicians are on the phone from 7AM to 7PM every business day. Almost any question you may have about a Dell system or its software can be answered over the phone.

And, in the rare case, that your question can't be answered by an on-line technician, we'll send a Honeywell Bull technician by the next business day.

A full year of on-site Honeywell Bull service is included within the purchase price of your Dell system.

Your Dell computer also comes with a thirty-day money back guarantee.

And we back every one of our computers with a one year limited warranty on any materials or workmanship.

For more information on Dell computers, read the reviews in the trade press, open the opposite page, review our product offerings, and call us at (800) 426-5150.

You'll like what we have to say.



*Dell Tech Support is open from 7AM to 7PM (CST) from Monday to Friday. In most cases, our technicians can answer any question over the phone. Even if the question involves a third-party component or software program.*

# More fast talk from the computer industry.

